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A CRITICAL REVIEW OF THE NORTH AMERICAN SACCOMYIDÆ.

BY DR. ELLIOTT COUES, U. S. A.

The small group of Rodents to be here treated consists of the genera *Saccomys*, *Heteromys*, *Dipodomys*, *Cricetodipus*, and *Perognathus*.[1] The animals are confined to North and Middle America and the West Indies. They are immediately recognized by the presence of ample cheek pouches, opening exteriorly and lined with fur, in connection with their general murine aspect—for the *Geomidæ* (*Geomys* and *Thomomys*), the only other rodents which have the same kind of cheek pouches, have an arvicoline contour, and are altogether different in external appearance.

This group appears to have been first put together—at any rate it was first satisfactorily defined—in 1857, by Professor Baird, who made it a subfamily (*Saccomyinæ*) of *Geomyidæ*. This sagacious naturalist seems to have been the first to perceive and act upon the really very close affinities subsisting between the *Saccomyidæ* and *Geomyidæ*, which had previously been widely separated in the system; but, in recognizing these relationships, he was led to the length of uniting the two groups as one family. As I have already shown,[2] the curiously different *shape* of the *Geomyidæ* and *Saccomyidæ*, which is of course only a matter of secondary consequence, is co-ordinated with structural characters of prime importance, fully warranting the erection of the *Saccomyinæ* into a family *Saccomyidæ*, distinct from, though unquestionably standing next to, the *Geomyidæ*.

We may consider that this fact was effectually, though only incidentally, exhibited in 1868, by Dr. J. E. Gray, in his "Synopsis of the Species of Saccomyidæ, or Pouched Mice, in the Collection of the British Museum." (P. Z. S. 1868, pp. 199-206.) Though using a terminology indicative of a subfamily ("Saccomyinæ"), this author speaks of "the family" of Pouched Mice.

In his "Arrangement of the Families of Mammals," 1872, Dr. Gill first formally catalogues a family *Saccomyidæ*, equivalent to the *Saccomyinæ* of Baird, 1857, and of Gray, 1868, which is placed next to the *Geomyidæ*, with which it constitutes one of this author's numerous taxonomic refinements, namely, a "super-family" *Saccomyoidea*. These groups, however, are merely named, no characters being furnished for their recognition. Use of the term "Saccomyoidea" seems to me to be one way of expressing the undoubted fact that the *Saccomyidæ* and *Geomyidæ* are more nearly related to each other than either of them is to the *Muridæ* or *Castoridæ*, between which they are interposed in Dr. Gill's system; through the practical utility of such "super" groups would be questioned by some naturalists.

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[1] *Abromys*, Gray, P. Z. S. 1868, 202, is not included, because the diagnosis is insufficient for its recognition. It is probably *Perognathus*.

[2] Bulletin U. S. Geol. and Geogr. Survey of the Territories (Hayden's), second series, No. 1, 1875, pp. —.

Thus determining a family *Saccomyidæ* (characters of which will presently be given), we may, before proceeding further, note what disposition has been made of its component genera. Dr. LeConte, in 1853, and Prof. Baird, both treated only of North American forms, recognizing simply two genera, *Dipodomys* and *Perognathus* (+ subg. *Cricetodipus*). Dr. Gill made no subdivision of the family. Dr. Gray went into this matter by dividing his *Saccomyinæ* (= *Saccomyidæ*) into two groups of no assigned value, namely, *Dipodomyina*, with *Dipodomys* alone, and *Heteromyina*, to include all the other genera. This division is based primarily upon the state of the molars, whether rootless (*Dipodomys*) or rooted. The *Heteromyina* of this author are further divided into those with sulcate superior incisors (*Perognathus*, "Abromys," and *Cricetodipus*) and those in which the upper cutting teeth are smooth (*Heteromys* and *Saccomys*).

I am insufficiently acquainted with *Heteromys* and *Saccomys* to say how nearly they approach, or how far they recede from, the *Perognathi* with which I am familiar; nor have I at present the material to inform myself. Of *Saccomys* I do not find that any one has precise knowledge at present; the very habitat of the animal is uncertain. To the orginal *Heteromys anomalus* (*Mus anomalus*, Thomps., Linn. Trans. XI. 151, pl. 10—*fide Gray*) Dr. Gray added several others in 1868, all from Middle America. As this author draws his characters, with the exception of those of the front teeth, entirely from some trivial superficialities which may be observed upon looking at stuffed skins, I am unable to gain from his remarks any satisfactory opinion respecting the degree of relationship subsisting between *Perognathus* and *Cricetodipus* on the one hand, and *Heteromys* and *Saccomys* on the other. My impression is, however, that characters of more than generic value will be found to distinguish them.

However the case may stand respecting *Heteromys* and *Saccomys*, concerning which precise information is greatly to be desired, it is demonstrable that the genus *Dipodomys* stands quite isolated from *Perognathus* and *Cricetodipus* by its extraordinary cranial peculiarities. This circumstance throws the North American genera into two distinct subfamilies, very easy to characterize.

In these preliminary remarks I wish, furthermore, to insist upon the full generic distinctions between *Perognathus* and *Cricetodipus*. The latter was first satisfactorily characterized as a subgenus by Prof. Baird, upon certain obvious and eligible external characters alone. But examination of the skull, which Prof. Baird, it seems, did not make, has satisfied me that the cranial characters are fully up to the current generic mark. *Cricetodipus*, in fact, makes a decided step away from *Perognathus* in the direction of *Dipodomys*, though still falling far short of the exaggerated peculiarities of the latter.

Family SACCOMYIDÆ (Baird).

= *Saccomyinæ*, Baird, Mamm. N. A. 1857, p. 404. (Subfamily.)
= *Saccomyinæ*, Gray, P. Z. S. 1868, 199. (Family.)
= *Saccomyidæ*, Gill, Arrang. Fam. Mamm. 1872, p. 21, No. 100.

Chars.[1] Skull light, thin, and papery, with few if any decided angles or ridges; rostrum elongate, attenuate, and tapering ; nasals projected beyond incisors. Inter-mastoid width not less than the inter-zygomatic, sometimes much greater. Inter-orbital space much wider than the rostrum. Occipital region formed largely or mostly of the mastoids. Palatal surface nearly flat and horizontal. No anteorbital foramen in a usual site, but a large, rounded perforation of the side of the maxillary, instead. Zygomata slender, depressed in position, almost or quite abutting behind against the tympanic; malar thread-like. A delicate scroll-like lachrymal, easily detached. Frontal broadly trapezoidal. Parietal broad, triangular or pentagonal. A large interparietal, embraced betwixt forks of the occipital. Squamosal almost entirely restricted to the orbit. Tympanic more or less inflated. Mastoid enormously enlarged and bullous, mounting to the top of the skull, and also forming much or most of the occipital surface, the occipital being correspondingly reduced, and scarcely or not forming part of the general occipital surface. Petrosals moderately inflated, their apices closely approximated or even in mutual contact. Coronoid process of mandible slender, sloping, prickle-like, scarcely or not attaining top of condyle; mandible small and weak in comparison with rest of skull. Incisors variable (the upper compressed and sulcate in North American genera, said to be broad and smooth in *Saccomys* and *Heteromys*). Molars $\frac{4-4}{4-4}$, rooted or rootless. General form murine; body slender and graceful; ears and eyes well developed. Hind limbs somewhat or decidedly saltatorial. Tail as long as the body (more or less). Fore claws moderate, not obviously fossorial. External cheek pouches ample, not connected with the mouth, furry inside, furnished with a special muscle (these pouches as in *Geomyidæ*, but no other rodents). Pelege generally coarse and harsh, said to be sometimes "spiny," always without under fur. The species very active and quick in their movements, like mice.

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[1] The characters are drawn from *Perognathus*, *Cricetodipus*, and *Dipodomys;* but there is every reason to believe that no essential modification of the phrase is required to embrace *Saccomys* and *Heteromys* as well. Special reference is had to antithesis with *Geomyidæ*.

The foregoing characters amply suffice for the determination of this family, though others might be adduced. The skull is very peculiar; its main features result from the exaggerated state of the mastoids, which produce great width behind, roof much of the cerebral cavity, pinch the occipital, and push the squamosal into the orbit. The next most prominent features are the slight thread-like malar, attenuated rostrum, and flat palate. The curious position of the anteorbital foramen is shared by the *Geomyidæ*. To bring the comparative characters of *Saccomyidæ* and *Geomyidæ* into strong relief, the following may be adduced :—

GEOMYIDÆ. (*Geomys and Thomomys.*)	SACCOMYIDÆ. (*Perognathus*, *Cricetodipus*, *Dipodomys.*)
Skull massive, angular, in general of an arvicoline type.	Skull delicate, with rounded-off angles and slight ridges, if any.
Interorbital constriction narrower than rostrum.	Interorbital space much broader than rostrum.
Interzygomatic width the greatest diameter of the skull.	Intermastoid width the greatest diameter of the skull.

GEOMYIDÆ. (*Geomys and Thomomys.*)	SACCOMYIDÆ. (*Perognathus, Cricetodipus, Dipodomys.*)
Palate strongly sloping downward far below level of zygomata.	Palate nearly horizontal, little if any below the level of zygomata.
Nasals not produced beyond incisors; rostrum broad, blunt, parallel-sided.	Nasals produced beyond incisors; rostrum compressed, tapering, acute.
Zygomata strong, flaring, with stout, short malar, having ordinary connections.	Zygomata slender, parallel, with long thread-like malar, almost or actually abutting against tympanic.
Frontal compressed.	Frontal very broad.
Parietals compressed, irregularly linear, remote from orbits.	Parietals broad, triangular or pentangular, coming to edge of orbits.
Squamosals roofing most of cerebral cavity, from roof of which mastoids are excluded.	Squamosals mostly or wholly restricted to the orbits; mastoids roofing much or most of cerebral cavity.
Tympanics contracted, tubular.	Tympanics more or less inflated, vestibular.
Petrosals widely discrete.	Petrosals approximating or in actual contact at their apices.
Occipital broad, forming most of occipital plane, but not mounting on top of skull.	Occipital contracted, scarcely or not entering occipital plane, but mounting top of skull, to there embrace interparietal between its forks.
Molars rootless.	Molars rooted (except in *Dipodomys*).
Large erect falcate coronoid overtopping condyle.	Small, sloping, prickle-like coronoid below condyle.
Lower jaw large and strong.	Lower jaw small and weak.
General form heavy, squat, clumsy—arvicoline.	General form light, lithe, and graceful—murine.
Fore limbs highly fossorial.	Hind limbs more or less saltatorial.
Eyes and ears minute.	Eyes and ears large.
Tail much shorter than body.	Tail nearly as long as or longer than body.
Pelage usually soft, lustrous, mole-like.	Pelage usually coarse and hispid.
Habits completely subterranean.	Habits exposed.

We may next illustrate the points of resemblance between *Saccomyidæ* and *Geomyidæ* as distinguished from other rodents, thereby showing the characters of the “superfamily” *Saccomyoidea* as named, but not defined, by Gill—the former family *Saccomyidæ* of Baird.

SACCOMYIDÆ and GEOMYIDÆ.—Mastoid bone inordinately developed, occupying much of the occipital or superior surface of the skull, or both. Occipital correspondingly reduced. No postorbital processes; no anteorbital foramen as such, in its stead a perforation in the side of the maxillary far forward and low down. Zygomatic process of maxillary an expanded perforate plate. Molars $\frac{4}{4}$. Root of under incisor more or less protuberant posteriorly. Descending process of mandible an obliquely twisted plate, projecting outward and upward. Large external fur-lined cheek pouches with special muscle; upper lip densely hairy, not visibly cleft; feet pentadactyle; fore claws longer than hinder ones. Pelage without under fur.

It will be observed that the differences outweigh the resemblances, notwithstanding the higher taxonomic value of some of the latter. The peculiar state of the temporal bone, the position of the anteorbital foramen, the shape of the jaw, and the presence of the pouches are the main common characters. In contrasting the two families, the very peculiar genus *Dipodomys* offers the strongest points of difference; but when we come to consider *Perognathus* and *Cricetodipus*, many of the expressions applicable to *Dipodomys* require modification. *Perognathus* is a link between the two families, just as, in its own family, *Cricetodipus* is between *Perognathus* on the one hand, and the extraordinarily modified *Dipodomys* on the other.

This brings us to consideration of what if any division may be made of the family *Saccomyidæ* into groups of more than generic value. The genus *Dipodomys* is so exaggerated in some of its peculiarities that, as it seems to me, its features may properly be set over against the characters which *Perognathus* and *Cricetodipus* share together. The leading antitheses may be indicated in the following manner:—

Subfamily PEROGNATHIDINÆ.	Subfamily DIPODOMYINÆ.
(*Perognathus* and *Cricetodipus.*)	(*Dipodomys* alone.)
Molars rooted.	Molars rootless.
Anterior molar with a lobe in addition to the main prism.	Anterior molar a simple prism.
Skull half as wide as long, and two-thirds as high as wide.	Skull two-thirds as wide as long, and half as high as wide.
Mastoids moderately developed (for this family).	Mastoids extraordinarily developed (even for this family).

Subfamily PEROGNATHIDINÆ.	Subfamily DIPODOMYINÆ.
(*Perognathus* and *Cricetodipus.*)	(*Dipodomys* alone.)
Tympanic little inflated.	Tympanic completely bullous.
Occipital plane not, or not much, emarginate.	Occipital plane deeply emarginate.
Petrosals, though approximate, not in contact with each other, but with the basi-occipital throughout.	Petrosals in mutual contact at their apices, and fissured away from basi-occipital.
Zygomatic plate of maxillary of ordinary rodent character.	Zygomatic plate of maxillary roofing much of the orbit.
Parietals pentangular.	Parietals triangular.
Interparietal wider than long.	Interparietal longer than wide.
No pit on inner side of jaw near the molars.	A deep pit on inner side of jaw near the molars.
Hind limbs little if any longer than the fore, not very obviously saltatorial.	Hind limbs elongated, jerboa-like, highly saltatorial.
Soles naked or sparsely pilous.	Soles densely hairy, like a rabbit's foot.
Pelage comparatively coarse and harsh.	Pelage comparatively soft.
Inner hind digit moderately developed and low down.	Inner hind digit rudimentary and elevated.

I am unable to say how nearly the genera *Saccomys* and *Heteromys* may coincide with the characters of *Perognathidinæ* as here established; but it is my impression that they will prove to constitute a third subfamily. In such case, some of the characters of the three would be as follows:—

DIPODOMYINÆ. Molars rootless; upper incisors compressed, sulcate.

PEROGNATHIDINÆ. Molars rooted; upper incisors compressed, sulcate.

SACCOMYINÆ. Molars rooted; upper incisors broad, smooth.

Subfamily PEROGNATHIDINÆ, Coues.

The characters of the group having been already sufficiently elucidated, it only remains to note the two genera by which it is represented in North America. These may be readily distinguished by much stronger characters than any hitherto adduced.

Genus *Perognathus.*	Genus *Cricetodipus.*
Occiput nearly plane, *i. e.*, the mastoids not projecting noticeably back of the occipital.	Occiput with a broad emargination, *i. e.*, the mastoids bulging decidedly back of the occipital.
Apices of petrosals separated by the whole width of the basisphenoid.	Apices of. petrosals almost meeting beneath the basisphenoid.
Parietals perfectly pentagonal, with nearly equal sides.	Parietals imperfectly pentagonal, inæquilateral.
Interparietal elliptical, much broader than long, embraced between narrow plates of occipital.	Interparietal pentagonal, shield-shaped, embraced between mere spurs of the occipital.
Ear with a distinct upright lobe of the antitragus, and generally also a lobe of the tragus.	Ear with no vestige of a lobe either of antitragus or tragus.
Soles naked to the heels, at least along a central stripe.	Soles entirely hairy on the posterior half.
Size of Mus musculus, or much larger.	Very diminutive; much less in size than Mus musculus.

The cranial characters above adduced, it may be observed, are all co-ordinated with the single main feature of much greater development of the mastoid in *Cricetodipus* than in *Perognathus*, the state of the parts in the former being an evident approach to the peculiarities of *Dipodomys* itself. The difference in the shape of the occiput is very striking when skulls of the two genera are laid beside each other—the part in *Perognathus* being quite flat, as in most rodents, while *Cricetodipus* shows an emargination, much broader and shallower than in *Dipodomys* indeed, but still well marked. These cranial peculiarities, substantiating a genus *Cricetodipus* distinct from *Perognathus*, do not appear to have been noted before. They are correlated with the excellent and readily appreciable external characters of the feet and ears already presented by Prof. Baird.

I. Genus **PEROGNATHUS**, Maxim.

=**Perognathus**, Maxim., Nov. Act. Acad. Cæs.-Leop. Carol. XIX. 1839, 369. Type, *P. fasciatus.*

<**Perognathus**, LeConte, Proc. Acad. Nat. Sci. Phila. 1853, 224; includes *Cricetodipus.*—Baird, Mamm. N. A. 1857, 416; includes *Cricetodipus.*

Having already indicated the generic characters of *Perognathus*, I need only here give some further details respecting the skull and teeth, following with an analysis of the species. I have before me skulls of all the described North American species excepting *fasciatus*. They are so nearly similar, that description of one will suffice for all, barring some slight ultimate details of size, etc. I select that of *P. penicillatus* for description, omitting generalities already presented. The description may be compared with that of *Dipodomys* given beyond.

Although the temporal bone is largely developed in the mastoid element, that lacks the enormous inflation seen in *Dipodomys*, the general shape of the skull being not dissimilar to that of several allied rodents. Nevetheless the mastoid represents the postero-exterior aspect of the skull, and is large enough to crowd the squamosal into the orbit, and cause a slight protuberance beyond the actual plane of the occipital bone. But this is insufficient to produce even the moderate emargination of this surface witnessed in *Cricetodipus*, and is nothing at all like the regular cleft or chink seen in *Dipodomys*. The ends of the petrosals are fairly separated by the width of the basisphenoid; they lie in contact throughout with the basioccipital, and show a conspicuous foramen posteriorly on the inner side. The meatus auditorius appears as a mere flange-like projection, intermediate in character between the swollen vestibule of *Dipodomys* and the contracted tube of *Geomyidæ*, though nearest the latter. The occipital is broader than in any other genus of the family, the forks which embrace the interparietal being fairly laminar, instead of mere spurs. The interparietal is much wider than long. The parietals are almost perfectly pentangular. A slight spur of the squamosal pushes out toward the meatus, but does not extend as a long clasp over the tympanic;[1] the squamosal is otherwise wholly orbital. The frontal is quite flat on top, squarely and straightly truncate behind, serrate in front for articulation with the rostral bones, and with straight sides convergent posteriorly. There is a large lachrymal of wholly irregular shape, extensively scroll-like, very delicate in texture, and loosely attached; it closes a large aperture leading into the nasal chamber. The orbit is also perforate behind by a single very large foramen of exit of cranial nerves. It is bounded in front, but not roofed over, by the zygomatic plate of the maxillary, not noticeable in character. The extremely delicate malar sutures in front for a long distance clasp-like against the zygomatic process; behind it simply abuts against a slight heel of the squamosal, almost in relation with the tympanic. The singularly displaced "anteorbital" foramen is a large rounded aperture in the side of the snout, communicating directly with the nasal cavity. The nasal bones are parallel-edged for most of their length, but widen a little and become semi-tubular anteriorly where they project; they are truncate behind, reaching opposite the middle of the jagged fronto-maxillary suture. The sides of the rostrum are contracted below, leaving a very narrow bridge of bone between molars and incisors; the contracted incisive foramina are bounded behind by the maxillaries, though they are chiefly pierced in the intermaxillaries. The intermolar portion of the palate is longer than wide, and a little convergent anteriorly; the maxillo-palatine suture is opposite the second molar; there is a pair of deep palatal pits opposite the last molars; behind there is a pair of much larger vacuities bounded by palatals in front, sphenoid behind, and pterygoids internally. The latter are simple, straight, nearly parallel processes, bounding the contracted posterior nares, and abutting against the petrosals. The orbital plate of the sphenoid is of moderate extent, owing to the size and site of the squamosal.

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[1] In a specimen of *Cricetodipus*, I clearly see that a long slender spur is sent out from the squamosal, like a clasp or hasp, lying above and reaching back of the meatus. *Cf.* what is said of an apparently similar, but not well made out appearance in *Dipodomys*, beyond. It is, in this case, a slender remnant of squamosal bone, left in an ordinary place, after most of the bone has been shoved into the orbit by the encroachment of the mastoid.

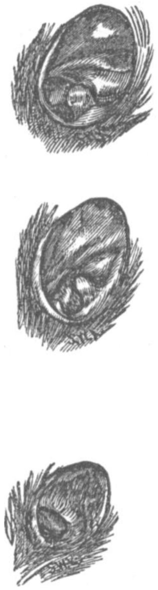
The molars in this genus, as in others of the family excepting *Dipodomys*, are all rooted. They have been said to have four roots, but such is not the case in the specimens I have examined. In *P. penicillatus*, all the upper molars have three roots apiece, and all the under molars have two roots apiece, excepting the back upper one, which has but one. The front upper molar has one root in advance, corresponding to the anterior lobe of this tooth, and a pair of roots obliquely side by side behind. The next two upper molars have each an exterior pair of roots, lengthwise, and a larger single root on the interior side; the back upper molar is simply single-rooted. The under molars have each a pair of roots, alligned lengthwise in a single series, but the two roots of the back lower molar are imperfectly distinguished. With these last exceptions, each root of all the teeth has its own distinct socket in the alveolus.

In the perfectly unworn state, the crowns of the molars are studded with tubercles in regular transverse series. In the upper jaw the anterior molar has four, an anterior, a posterior, an exterior, and an interior, with perhaps another one part way up the anterior lobe. The second and third upper molars have each six tubercles, in two straight transverse rows of three each, these rows separated by a deep sulcus. The smaller circular back upper molar tends indistinctly to a similar state. In the lower jaw the tuberculation is very similar; but the four tubercles of the first molar are in an anterior and posterior pair, and on the last one the tubercles become indistinct.

The teeth present a very different aspect when the tubercles are ground off with wear. Each transverse row of tubercles becomes converted into an island of dentine, there being thus, on the intermediate molars at any rate, a pair of such transverse dentine islands separated by a double ridge of enamel partition, between which is the bottom of the sulcus already mentioned. This enamel fold makes in from the outer side of the tooth nearly to the inner side. The front molar shows a little isolated island of dentine anteriorly, nearly circular, and a broad transverse one posteriorly. The state of the under teeth is essentially the same.

The upper incisors are small, compressed, with a strong backward set. Their face is deeply channelled with a longitudinal groove, and the exterior moiety is rabbeted down so that the groove is visible laterally as well as from the front. This is a prominent character, shared by *Cricetodipus* and *Dipodomys*, in distinction from *Saccomys* and *Heteromys*. The under incisors are small and simple.

Before leaving this portion of the subject, I may as well mention a curious circumstance: the ease with which the skulls of *Perognathus* and *Cricetodipus* break apart across the middle. This seems to be chiefly due to the delicate state of the zygomata, which afford no stable connection between the fore and aft parts. The break occurs at the basispheno-occipital, squamo-mastoid, and fronto-parietal sutures—the parietals, temporals excepting squamosals, with the occipital, coming away from the rest of the skull.



Explanation of figs. Left ear, in each case, twice natural size; upper fig. *P. monticola;* middle fig. *P. penicillatus ;* lower fig. *Cricetodipus flavus.*

There appears to be something peculiar, in the habits perhaps, rather than in the scarcity, of the species, which prevents the acquisition of large series of specimens in this family. While hundreds of examples of animals no larger or more conspicuous than these are readily amassed, collections are all deficient in *Perognathus* and *Cricetodipus*, and not very full in *Dipodomys*. I have not been able to examine more than a hundred specimens altogether, and of these more than half were *Dipodomys*. Of *Perognathus* I have however specimens of all the described North American species, including all of Baird's types and considerable additional material. After protracted examination, I endorse the validity of all the species admitted by that author in 1857, and find indications of the probable existence of one or two more. This point is fully discussed beyond. The species that appear to be established may be readily determined by the following analysis, viz:—

A. Notch of the ear bounded in front by a slight, though distinct, lobe of the tragus. Whole fore leg white.

a. Tail penicillate, crested at the end, rather longer than the body and head. Sides with no fulvous stripe. PENICILLATUS.

b. Tail simple; sides with a strong fulvous stripe.

1. Tail decidedly shorter than the body and head. Length about 4 inches. Pelage moderately stiff. Mixed sandy and blackish. FASCIATUS.
2. Tail not shorter than head and body. Length about 3 inches. Pelage very hispid. Mixed cinnamon and blackish. . . HISPIDUS.

B. Notch of ear formed in front directly by the edge of the conch. Fore leg mostly colored like the back.

Tail simple ; lateral stripe obscure. . . . . MONTICOLA.

Perognathus fasciatus, Maxim.

Perognathus fasciatus, Maxim., N. Act. Akad. Leop-Caes. Nat. Cur. xix. pt. i. 1839, 369, pl. 34 ; Reise Nord-Am. i. 1839, 449 ; Arch. f. Naturg. 1861, ; Verz. Reise, 1862, 175, pl. 4, f. 6, 7. Wagn., Arch.

f. Naturg. 1841, 45; Suppl. Schreb. iii. 1843, 612. Schinz, Syn. Mamm. ii. 1845, 259. LeC., Proc. Acad. Nat. Sci. Phila. vi. 1853, 224. Aud. & Bach., Q. N. A. iii. 1854, 341 (compiled). Giebel, Säugeth. 1855, 572 (compiled). Bd., M. N. A. 1857, 421 (Chihuahua). Bd., U. S. Mex. Bound. Surv. ii. pt. ii. 1859, Mamm. p. Suckl., P. R. R. Rep. xii. pt. ii. 1860, 101 (compiled). Gray, P. Z. S., 1868, 201.

Perognatus fasceatus, Lincecum, Am. Nat. vi. 1872, p. 369 (habits).

Prognathus faceatus, Lincecum, Am. Sportsman, Feb. 28, 1874 (habits).

Diagn. Largest of the genus; considerably exceeding *Hesperomys leucopus*, and approaching *Tamias quadrivittatus* in size; length four inches or more; tail less; hind foot about one inch. Tail decidedly shorter than head and body, not penicillate. Ears large; antitragus distinctly lobed. Soles naked to the heels—at least along a median strip. Above, reddish-yellow, closely lined with blackish; below, including fore leg all around, white; these two colors separated by a conspicuous stripe of fawn color or salmon red running the whole length of the body; tail distinctly bicolor.

Hab. United States, west of the Mississippi and east of the Rocky Mountains, and northern portions of Mexico. (Originally described from the mouth of the Yellowstone; re-described from Chihuahua. Specimens examined by me from Nebraska, Kansas, Texas, and Chihuahua.)

I regret that the material before me includes no specimens in the flesh, since I am thereby prevented from giving the size and form of the species with desirable precision; fortunately, however, in this instance the characters of the species are so strongly marked, that lack of elaborate details of form will result in no misunderstanding. The coloration, alone distinctive, can be accurately given from several well-prepared skins before me.

This species, the type of the genus, exhibits very distinctly the two leading features of external anatomy which distinguish *Perognathus* proper from *Cricetodipus;* namely, the lobe of the antitragus and the naked strip of the sole extending quite to the heel. It is much the largest species of the genus known to inhabit the United States, considerably exceeding *P. penicillatus* (which about equals *Hesperomys leucopus* in size), and in fact, some specimens are little if any smaller than *Tamias quadrivittatus.* For the reason above given, the dimensions cannot be stated with precision; but the length from nose to root of tail is obviously more than four inches in all but one of the specimens before me; the tail is decidedly shorter than the head and body (in all the other species treated in this paper it is as long or longer). The vertebræ of the tail of the only specimen before me in which these bones remain in situ, measure less than 4.00 inches, the length of the head and body of the same specimen being about 4.50. Likewise the hind feet are proportionally shorter than in any of the other species; they average only one inch in length, thus not exceeding those of *P. penicillatus*, which is a smaller animal. On the contrary, the ears are larger, both absolutely and relatively, than those of any other species, standing about 0.40 high, measured from the notch; the ears thus project conspicuously above the fur of the parts; the flap is suborbicular in outline; the antitragus develops a very prominent lobe, bounding the notch posteriorly; and in front of the notch there is also a little prominence, just behind the termination of the margin of the ear. The flattened portions of the auricle are sparsely pilous inside and out, and a tuft of lengthened hairs springs from the front border of the ear.

The attenuated and elongated muzzle is densely pilous, excepting a small T-shaped nasal pad, divided by a median depression. The upper lip, in particular, is thickly covered with stiffish, flaring hairs, completely concealing any median cleft which may exist, and forming a heavy fringe which droops over and almost hides the incisors; there is a reversed tuft of bristly hairs on the chin. The openings of the cheek pouches seem to have no peculiar character, being much as in other species of the genus; the cavity admits the first joint of one's little finger. The whiskers are very numerous and fine; the shorter colorless ones seem like mere lengthening of the hairs of the muzzle; others, stiffer and colored, reach rather beyond the head. There are also some long special bristles over the eye, and others between the eye and ear.

The palm proper, and under surfaces of the digits, are perfectly naked, though a considerable fringe of hairs falls down from the wrist. There is a large and conspicuous smooth tubercle on the outer side, at the base of the fifth digit; two others, one on each side, at the wrist, and others at the bases of the intermediate digits; the disposition of these smaller ones is not very evident in the dried specimens. The thumb is rudimentary, a mere stump, bearing a flattened obtuse nail; the other digits are armed with ordinary compressed, acute and moderately curved claws; the 3d is longest; then come 4th, 2d, and 5th in succession. Of the hind foot, the sole is perfectly naked for its whole length along a median strip, narrowed by encroachment on either side of a fringe of hairs. On the outer side, about half-way from heel to base of digits, is a small tubercle; there is another near the base of the 1st digit, and a much larger one near the base of the 5th digit, with others still at the bases of the intermediate digits; but their precise disposition, and the character of the naked sole cannot be made out perfectly. The first digit is very small, with a smooth bulbous end and short blunt claw; the other claws are of a more ordinary character, but relatively shorter, blunter, less compressed and less curved, than those of the hand; they are excavated underneath.

The tail is completely but rather thinly haired; and, especially toward the end, the hairs stand apart and are somewhat lengthened (as is usual in the genus); still they do not develop into the decided comb or crest, or tuft at the end, which is characteristic of *P. penicillatus.*

The pelage of this species is coarse, harsh, and stiffish (as in other species of typical *Perognathus*), though not to a degree which could bear the term "spiny" or even bristly; it has been likened to fine-spun glass, though such expression might be considered strong, unless excessively delicate glass is meant. The fur has considerable gloss; there is no under fur whatever. The character seems to me to be much as in the murine *Sigmodon hispidus*, and in fact the specimens before me have considerable superficial resemblance to the young of that species. A likeness to *Jaculus hudsonius* is perhaps even stronger. The color of the upper parts is a light sandy-yellowish, closely lined throughout with blackish, producing a fine grizzle. The greater part of the length of the individual hairs is the color of barely tarnished cut lead; rather light, and unlike the heavier plumbeous of most rodents. This is succeeded by the sandy ends of the hairs; a part of them are of this last color to the very end, while others have the tips blackish, producing the grizzle above mentioned. The line of demarcation of this color begins on the side of the nose, and runs straight over the shoulder and sides of the body, descending the hind limb to the heel. To this succeeds a strip of rich reddish-yellow or salmon-color, beginning on the cheeks and following the line already indicated to the heels, but also descending a little way on the fore leg. This color is pure, the hairs being so colored to the roots, there being no plumbeous basal portions and no blackened tips. The whole under surface, together with the feet, most of the fore leg and the inner aspect of the hind leg, is white, and on these white areas the hairs are of this color to the roots. The line of demarcation with the fawn color is pretty sharp, but less so in some cases than in others, sometimes the whole belly showing a tawny shade. The tail is bicolor; a brown or dusky stripe runs the whole length of the upper surface; the sides and under surface being white or tinged with rusty; the latter particularly when the white of the belly is similarly tinged. Besides these special markings, there is decided indication of a dusky stripe from the nose under the eye and ear to the side of the neck, produced by increase of the blackened tips of the hairs along the line. Some of the whiskers are black, others being colorless. The pouches are white inside. The claws are colorless.

The series of specimens at my command does not suffice for a complete exposition of the variation in color of this species. In all the lateral stripe is conspicuous, and the other characters differ little. I note, however, a decidedly richer tone in the Mexican and Texan specimens than in those from Kansas and Nebraska.

It is probable that the skull of this animal, when examined, will afford some appreciable specific characters, in size at least, if not in details of conformation.

Perognathus penicillatus, Woodh.

Perognathus penecillatus, Woodh., Proc. Acad. Nat. Sci. Phila. vi. 1853, 200. (San Francisco Mts., Arizona.)

Perognathus penicillatus, Woodh., Sitgreaves' Rep. Expl. Zuñi and Col. R. 1853, 49, pl. 3.—Le C., Proc. Acad. Nat. Sci. Phila. 1853, 225. (Mere mention.)—Aud. and Bach., Q. N. A. iii. 1854, 298. (Copied from Woodh.)—Bd., M. N. A. 1857, 418, pl. 20, f. 5.—Gray, P. Z. S. 1868, 201. (Wrong locality assigned.[1])—Coues, Am. Nat. i. 1867.

Perognathus parvus, Le Conte, Proc. Acad. Nat. Sci. Phila. vi. 1853, 225, in part. Not *Cricetodipus parvus*, Peale. (The specimen noticed, from the Colorado Desert, is apparently a very young example of *P. penicillatus*.)

Diagn. About the size of *Hesperomys leucopus*. Tail vertebræ obviously longer than head and body. Hind foot more than one-fourth the length of head and body. Tail crested above towards the end, and with long terminal pencil of hairs. Soles distinctly naked to the heels, at least along a median strip. Antitragus distinctly lobed, with a sharp teat-like projection, opposite which is another smaller but distinct lobe of the tragus, the notch of the ear being defined by these two prominent points, the edge of the ear itself not bounding the notch at all. No appreciable fulvous stripe along the sides, where the color of the upper parts meets the white of the under parts without intervention of a third color. Above, gray; an intimate mixture of yellowish-gray with a dull grayish-brown; below, including whole fore leg, fore and hind feet, and inner aspect of thighs, white; tail bicolor—dark above, white below. Length about 3.25 inches (2.90–3.60); tail vertebræ about 4.00 (3.50–4.40), with a tuft half an inch or more longer. Soles about 0.95 (0.90–1.00); ear above notch, 0.33 (0.30–0.35).

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[1] The San Francisco Mountains are several hundred miles from San Francisco City, California, nearly in the middle of Arizona—formerly a part of New Mexico. The locality appears to puzzle some writers.

Hab. The basin of the Colorado River. (The very few specimens at present known to naturalists have all come from Arizona and the adjoining border of Southern California.)

Description (from Woodhouse's type (mounted), and several more recent specimens, dry and in the flesh).—In all the other species of *Perognathus* given on these pages the tail, whether longer than the body or decidedly shorter, is simply haired, with the terminal hairs no longer than those surrounding the tail. The present species is therefore remarkably distinguished by the comb or crest of long hairs on the terminal third or more of the member, produced by a gradual lengthening until those at the end are half an inch or more in length, producing a penicillate brush proportionally as long as that of some species of *Tamias* or even *Sciurus*. With this singular character others of equal tangibility are coördinated. The description to be given will include some points common to the genus, as, with one exception, the present is the only species of *Perognathus* of which I have specimens in the flesh.

The head is about one-third of the total length of head and body; broad and full across the temporal and orbital regions, thence tapering rapidly to the produced but rather blunt snout. The muzzle is entirely and densely pilous excepting a small nasal pad, with a median furrow; the nostrils are very small and irregular in contour. The long upper lip is heavily clothed with stiffish hairs, forming a fringe which droops over and hides the incisors. The whiskers are numerous and very fine; besides the labial set, the longest of which much exceed the head in length, there are others about the eye and ear. The eye is of moderate size, and situated much nearer to the ear than to the nose. The ear shows very conspicuously the prominent lobe of the antitragus which is the chief external peculiarity of this genus as compared with *Cricetodipus;* and opposite to it, on the other side of the notch, there is a similar and smaller but still very evident tubercle, just within the border of the ear. These two prominences together cause the notch of the ear to be very strongly defined, and the margin of the external ear is altogether excluded from the notch. The contour of the ear is broadly rounded. The slit of the cheek pouch is about half an inch long, beginning on the side of the upper lip and curving around with a free border to near the angle of the jaw, there being but narrowly separated from its fellow.

The details of the palms and soles, as clearly made out from the material before me, are probably applicable also to those other species of the genus of which only dried skins are before me. The palm is entirely naked; it presents posteriorly a pair (inner and outer) of immense smooth tubercles, reminding one of the state of the parts in *Geomys.* Anteriorly there are three smaller but still very conspicuous bulbs; one at the base of, respectively, the 2d and 5th digits, and one at the conjoined base of the 3d and 4th. The palm is otherwise uniformly studded with small elevated granulations, and the digits are similarly roughened underneath. The minute thumb ends club-shaped, bearing upon its back a flat nail, which, like those of the human fingers, does not project at all beyond the end of the digit. The whole thumb is no more conspicuous than one of the palmar pads. The other digits bear ordinary claws; the 3d is longest; the 2d and 4th are subequal to each other and but little shorter than the 3d; the 5th is more abbreviated, but its claw-tip still falls beyond the base of the 4th claw.

As a consequence perhaps of the desert habitat of this species, the nakedness of the sole, which is one of the secondary characters distinguishing the species of *Perognathus* from those of *Cricetodipus*, is here carried to an extreme. The sole may be called naked without qualification; for the fringe of hairs which droops over its sides does not encroach in the least upon the under surface except just at the side of the contracted posterior part of the heel itself. The whole sole is uniformly paved with minute granulations. Among these, one constantly larger than the rest is always observed on the inner side about half way down the metatarsus; and a similar one is found at the base of each of the digits. The digits are marked beneath with transverse lines of impression, and end in a smooth slightly clubbed tip. The first digit, though small, is perfectly formed, and bears an ordinary claw, the tip of which falls opposite the base of the second digit; the longer 3d digit but slightly exceeds the 2d and 4th, which are about equal to each other; the end of the claw of the 5th digit falls opposite the middle of the 4th one.

In the development of the hind limbs of this and the next closely allied species of *Perognathus*, there is more indication of a saltatorial tendency than appears in the case of *P. fasciatus*, but the difference is not very striking; it is no more than that which may be inferred on comparison of *Cricetodipus parvus* with *C. flavus*, and it falls far short of the state of the case exhibited by *Dipodomys*. Still, the supposed saltatorial character is further borne out, upon analogy, by the peculiar character of the long penicillate tail, already fully described.

I find it difficult to describe the color of the upper parts satisfactorily. It has been called "a light dull yellowish-brown or tawney, lined with dark-brown." The prevailing tone is decidedly "gray" in comparison with the strong mixed yellowish and blackish of *P. fasciatus*—somewhat the shade of dilute coffee and milk. The lighter hairs are dull yellowish-gray, with darker lining of hair brown. There is a general tinge of the palest possible cinnamon. All the bases of the hairs are of the color of fresh-cut lead. There is no appreciable lateral stripe of different color from the upper parts, although just along the line of junction with the white, the color lightens a little for lack of the darker brown lining. The extreme tip of the snout, the cheeks, the whole fore leg, the inner aspect of the hind leg, the feet, under side of tail, and under parts generally, are white; the line of demarcation runs straight from nose to hind leg, where it drops down to the heel. The upper surface of the tail and the brush at the end are hair-brown. Some of the whiskers are black; others, like the claws, are colorless.

The external sexual characters of this and other species of the family are readily recognizable. In consequence of the development of the os penis, the præputial sheath is a resisting prominence immediately in advance of the anus; the same part in the female, shows a conical flap depending from the front of the vulva.

Having only about a dozen adult specimens of this species to examine, the full range of variation can only be given with approximate accuracy. Still the series is a very good one as far as it goes, and the number of alcoholics afford reliable measurements. Dr. Woodhouse's type is much faded by twenty years' exposure to the light. The others agree perfectly in coloration, and the differences in size are slight. I may here remark, that in the table of measurements given by Prof. Baird, the dimension (nose to tail) given from the dried specimens there enumerated is certainly over the mark. Thus, Woodhouse's type is given as 4.12 long, whereas the original description of the same specimen gives this dimension as 3.50.

Measurements.

Current Number.	Locality.	Sex.	From tip of Nose to				Tail to end of		L'th of		Height of ear.	Nature of Specimen.
			Eye.	Ear.	Occip.	Tail.	Verteb.	Hairs.	Fore ft.	Hind ft.		
2676[1]	San Francisco Mts. Arizona...	....	....	0.90	....	3.50	3.70	....	0.40	1.00	0 30	Mounted.
1332	Colorado R. Cal...	....	....	....	....	....	3.00	3.60	....	0.90	....	Dry.
1333	Fort Yuma, Cal...	....	....	....	....	....	3.65	4.15	0.40	0.95	0 30	Dry.
1349	Colorado Desert, Cal.	....	0.50	0.90	1.00	2.50	3.15	....	....	....	....	Alcohol.
8910	Camp Grant, Ariz.	♀	0.60	0.95	1.10	2.90	3.50	4.00	0.35	0 85	0.30	"
4924*a*	Mojave Village "	♂	0.65	1.00	1.25	3.30	....	....	0.45	1.00	0 33	"
4924*b*	" " "	♀	0.55	0 90	1.10	3.00	3.50	4.00	0.40	0.95	0.35	"
4924*c*	" " "	♂	0.55	0.90	1.10	3 00	4 00	4.60	0.40	0 90	0.30	"
4924*d*	" " "	♂	0.60	0.95	1.20	2.90	4.25	4.80	0.40	0.95	0.35	"
4924*e*	" " "	♂	0.65	0.95	1.20	3.50	4 30	4.90	0.40	1.00	0.35	"
4924*f*	" " "	♂	0.60	0 90	1.20	3.60	4 40	5.00	0.40	1.00	0.35	"

Taking the last seven sets of measurements of the foregoing table (all made from sexed specimens in the flesh, and taken by the same person,[2] so that a source of error which lies in different methods of measurement is avoided) we observe that the total length varies from 2.90 to 3.60—a difference of 0.70—a fair rate of variability for a species. The tail, as usual, varies more than the body, or, in this instance, about an inch, whether the vertebræ alone being considered, or the terminal pencil be taken into account. The relatively shortest tail (vertebræ alone), is half an inch longer than the head and body, or, with the hairs, an inch longer. The relatively longest tail (vertebræ alone), is an inch and a quarter longer than the head and body; with the hairs, nearly two inches longer. Much as usual, the rate of relative variability is greater than that of absolute difference in dimension. The soles vary a tenth of an inch in length, or about 9½ per cent. of their average length. Other smaller measurements give corresponding results. The rates of variation, which are determined for the present species, are doubtless equally applicable to others of the genus, of which I have no alcoholic specimens.

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[1] The measurements of length and of tail vertebræ are from Woodhouse. In its present state the tail, as well as can be judged, is about 4.50 long, exclusive of the terminal pencil, which is half an inch more. The dry measurements are not reliable.

[2] In measuring tails, I take as nearly as possible the true length, by placing one leg of the compasses snugly above the anus. The length to which the tail projects beyond the body-hairs, or its ostensible dimension, is considerably less.

Upon the supposition that the other allied species described in this paper are really distinct from *P. penicillatus*, this has a remarkably restricted geographical distribution. So far as I am aware, there are no specimens extant from beyond the limits of the Colorado Valley, in that portion of its extent which embraces Arizona and the contiguous part of California on the opposite side of the river. Specimens are rare; there may be none whatever in Europe. Woodhouse, LeConte, Baird, and myself, are, perhaps, the only naturalists who speak of the species from autoptical examination.

The relationships of some allied species being considered under other heads, the only point now arising for discussion relates to the "*Cricetodipus parvus*" of LeConte, l. c. The specimen upon which the writer based his remarks is now before me. It is not adult, as supposed, but very young and ungrown, as shown by the unworn state of the teeth; although the tail is not crested, there are indications that it would have become so; the relative proportions and coloration are exactly as in *P. penicillatus*, to which I have little hesitation in referring it. In any event it is a true *Perognathus*, and not *Cricetodipus* at all, as shown beyond question by the obviously naked soles and distinctly recognizable lobe of the antitragus.

Perognathus monticola, Baird.

Perognathus monticola, Baird, M. N. A. 1857, 422, pl. 51, figs. 3*a–h* (St. Mary's, R. Mts.). Suckl., P. R. R. Rep. xii. pt. ii. 1860, p. 101 (notice of the same specimen).

Diagn. (No. 7251, ♀, Fort Crook, Cala., J. Feilner.) Size of *Mus musculus.* Tail, including hairs, an inch longer than the head and body, the vertebræ alone over half an inch longer. Hind foot nearly one-third as long as head and body; naked strip on sole very narrow posteriorly; antitragus with a great, flat, rounded, upright lobe, but no lobe of tragus opposite, the notch being defined in front by the outer edge of the ear itself. Tail not penicillate nor crested; rather thinly but nearly uniformly haired throughout. Pelage very soft and smooth for this genus—much as in *Cricetodipus.* Color of upper parts descending on the fore leg to the wrist. A fulvous lateral stripe, indistinct but evident; hairs of under parts pure white to the roots; tail bicolor. Above yellowish-cinnamon lined with blackish, the latter predominating; below, white. Length 2.50; tail vertebræ 3.20; hind foot 0.80.

Hab. St. Mary's Mission, W. of Rocky Mts. to Otter Creek, Utah, and Fort Crook, California.

Description.—The generalities of form of this animal are much the same as those of its nearest allies. In relative length the tail nearly equals that of *P. penicillatus*, but it is uniformly haired throughout, without indication of crest or penicillation. The soles are not so extensively denuded as those of *P. penicillatus*, owing to encroachment of hairs from the sides; still there is a fairly naked strip to the extreme heel. The tuberculation of the palms and soles, and the proportions of all the digits, are substantially as in that species. The animal is much smaller than any other species of the genus, not much exceeding a *Cricetodipus* in size. But the most remarkable character is found in the structure of the ear—it is singular how sharply distinguished some species of the genus are in this respect. In *P. penicillatus* a sharp teat-like projection of the antitragus defines the notch posteriorly, and opposite to it on the other side of the notch, there is a similar but smaller prominence of the tragus bounding the notch anteriorly; thus the external edge of the ear itself is altogether excluded from formation of the notch. Now in *P. monticola*, the lobe of the antitragus is a broad, flat, upright flap, both relatively and absolutely larger than that of *P. penicillatus*, but there is no corresponding lobe of the tragus on the other side of the notch, the front border of the notch being formed by the external edge of the ear itself; this state of the parts is an approach to the condition seen in *Cricetodipus*, and is a perfectly distinctive mark of *P. monticola* in its own genus. This important distinction escaped the describer of the species; but it should be added that it is only fully appreciable upon examination of fresh or alcoholic specimens, and that the type of the original description had been mounted when examined. Furthermore, the ears of *P. monticola* are smaller than those of *P. penicillatus*, and scarcely more than half the size of those of *P. fasciatus*.

Another good character of the species is found in the softness and fineness of the fur. The pelage not so stiff and firm as in *P. penicillatus* even, and has nothing of the "spun glass" character seen in *P. fasciatus* and still more so in *P. hispidus*.

The coloration of the species is mainly distinctive in the circumstance that the dark color of the upper parts descends the fore leg to the wrist, whereas on all the other species examined the whole fore leg is white. The upper parts are an intimate mixture of tawny and blackish, much as in *P. fasciatus*. There is an evident but not very distinct lateral fulvous stripe. The under parts, in the specimen described (No. 7251), are light yellow, but this is undoubtedly the effect of alcoholic discoloration, the parts being no doubt white in life. The tail is bicolor to correspond with the body colors.

While there is no question whatever of the distinctness of the subject of the present article from any others described in this paper, there are some points to be considered respecting its reference to *P. monticola* of Baird. The type of this species now before me has been mounted and exposed to the light for about twenty years; it is faded and otherwise in poor state, the end of the tail and much of the fur being lost. The color is now a uniform dull grayish-brown, much like the natural color of *P. penicillatus*, instead of "mixed cinnamon and dusky," as originally described; and the tail is uniformly dingy white, instead of being "colored to correspond;" the hairs below are all white instead of "plumbeous at base;" and no lateral stripe is now appreciable, though an "indistinct" one was mentioned. But the main peculiarity of the species as to coloration, namely, the descent of the dark color down the fore leg to the wrist is still evident, and in short, I find no color differences not explicable upon consideration of the comparative state of the two specimens. We may therefore turn to the matter of size and proportions. Prof. Baird says, "tail rather shorter than head and body," giving the length of the former as 2.67+, and of the latter as 3.00; whereas my animal is but 2.50 long, and has a tail of 3.20. But the decided discrepancies in these statements and measurements are readily reconciled upon the simple consideration that the tail is defective and the body over-stuffed in the type of *monticola*. This brings about an agreement further borne out by the other measurements. In the following table, the first line of measurements are copied from Baird; the other is taken from the Fort Crook specimen, upon which this article is based, before skinning out of alcohol.

Measurements.

Current Number.	Locality.	Sex.	From tip of Nose to				Tail to end of		L'th of		Height of ear.	Nature of Specimen.
			Eye.	Ear.	Occip.	Tail.	Verteb.	Hairs.	Fore ft.	Hind ft.		
451	St. Mary's, R. Mts.	....	0.46	0.92	1.08	3 00	2.67+	....	..	0.80	0.25	Mounted
7251	Fort Crook, Cala.	♀	0.55	0.85	1.00	2.50	3.20	3.50	0.30	0.80	0.30	Alcohol.

The principal discrepancy being explicable as above, there is nothing whatever in the foregoing table incompatible with specific identity. Moreover, it so happens that the left ear of the type is in sufficiently good preservation to enable me to clearly recognize the peculiar conformation which distinguishes the present species from the others.

To this same species I am also inclined to refer two specimens collected by Mr. H. W. Henshaw on Otter Creek, in Utah. These are apparently young animals, but, as they are not accompanied with the skulls, the fact cannot be determined. The tail of each has been skinned, and is now so shrivelled that nothing can be predicated as to its length, either relative or absolute. The specimens are quite small; they have been over-stuffed, measuring now about 2½ inches, but were probably not much if any over 2, with a hind foot of 0.80; in fact they might be taken at first sight for a *Cricetodipus*. But the soles are naked along a narrow strip quite to the heel; the antitragus has a very prominent lobe; and even from the dried skins I determine, with no appreciable chance of mistake, that the ear has the other peculiarity of *P. monticola.* The pelage is remarkably soft; the coloration is different from that of any other *Perognathus* I have seen, being plumbeous (like the plumbago-colored specimens of *Geomys* and *Thomomys*), with little admixture of lighter color; and the soles show a decided fulvous stripe. But these specimens exhibit the fore leg colored quite to the wrist, and I am inclined to attribute the dark color to their immaturity. I shall therefore assign them to *P. monticola.*

The four specimens noticed are the only ones which have come under my observation. To sum the case in a few words, we have here an animal unquestionably distinct from any of the other species described in this paper, the only question being whether all the specimens referred to it are specifically identical. They ostensibly differ to a degree that would undoubtedly have caused them to be described as two or three species at the period when Prof. Baird's work was prepared. This question must await the reception of additional material for its satisfactory solution. I can only say that I am at present unable to see more than one species. Should the contrary be determined, the present article is to be held as based upon the Fort Crook specimen, to which the name of *P. mollipilosus* may be applied.

Perognathus hispidus, Baird.

Perognathus hispidus, Baird, M. N. A. 1857, 421, pl. 51, fig. 4 *a–g*. Baird, U. S. and Mex. B. Surv. ii. pt. ii. 1859, Mamm. p. —.—Gray, P. Z. S. 1868, 202 (compiled).

Diagn. Ear small, not projecting beyond the fur; its structure as in *P. fasciatus* and *penicillatus* (tragus and antitragus both lobed). Soles naked. Tail not penicillate, rather longer than head and body. Fur exceedingly stiff and coarse. Above yellowish-cinnamon, closely lined with blackish, the color not descending on the fore leg at all. Sides with a conspicuous fulvous stripe. Tail bicolor. Under parts, with hind feet and whole of fore leg, white. Length between 3.00 and 3.50; tail, rather more. Sole of hind foot 0.90.

Hab. The only two specimens known of this species were procured by Lt. Couch at Charco Escondido and Matamoras, Tamaulipas.

Since the introduction of this species, as above, no additional specimens have come to hand; and as we have no further material for amplification or verification of the original description, there is little more to be said about it at present. The animal appears to be perfectly distinct from any other described in this paper. With much the same size and proportion as those of *P. monticola*, it is immediately distinguished by the radical difference in the conformation of the ear, the stouter as well as rather longer feet, and the whiteness of the whole fore leg. From *penicillatus* it differs in the much shorter and not penicillate tail, less extensively denuded soles, and presence of a strong lateral fulvous stripe. It is decidedly smaller than *P. fasciatus*, with which it shares the fulvous stripe, with a tail longer instead of shorter than the body. Ears scarcely half as large, etc. From all these species finally, it differs in the extraordinarily harsh, stiff, coarse hair; this is of great length, and devoid of under fur, as in other species, but represents, in an exaggerated degree, the pelage which is characteristic of the genus, in distinction both from *Dipodomys* and *Cricetodipus*.

The coloration of the species cannot be given with sufficient accuracy. Both the specimens have been skinned out of alcohol, and the tints are probably somewhat modified. One of them has been so discolored by long immersion in a dirty fluid, as to be of a uniform dingy greenish-brown in which the original colors cannot be in the least discovered. The other, in better state, shows the characters pretty well. There is a strong fulvous or salmon-colored stripe along the whole body, just as in *P. fasciatus*. The light color of the upper parts is rather a pale cinnamon than the sandy yellowish of *P. fasciatus*. The hairs are light plumbeous at base, and many of them are tipped with black, giving the dark surface lining. The tail is sharply bicolor to correspond with the body. The under parts, including the whole fore leg and the foot and inside of the hind leg, are white.

As in the case of *P. monticola*, further information respecting this species is much to be desired, particularly as there appear to be some Mexican animals of this genus, with which we are at present not well acquainted. The following measurements are those given by Baird in his original notice:—

Measurements.

Current Number.	Locality.	Sex.	From tip of Nose to				Tail to end of		L'th of		Height of ear.	Nature of Specimen.
			Eye.	Ear.	Occip.	Tail.	Verteb.	Hairs.	Fore ft	Hind ft.		
577	Charco Escondido.	♀	0.64	0.93	1.33	3.12	....	....	0.42	0.84	0.37	Alco.
576	Matamoras.......	♂	0.67	1.00	1.33	3.50	3.60	3.80	0.45	0.92	0.37	Alco.

Note on "Abromys lordi," etc.

The foregoing pages embrace an account of all the species of *Perognathus* which have come under my notice. There are, however, several other described animals which appear to belong in this genus or in its immediate vicinity, one of these from the United States. This latter is the *Abromys lordi*, Gray, P. Z. S. 1868, p. 202 ; the following is the notice in full.

"3. **ABROMYS**, Gray.

"Upper cutting teeth with a longitudinal groove; fur soft, abundant, uniform, long, and close. Tail tapering, cylindrical, covered with short hair almost hiding the rings of scales.

"*Perognathus*, sp., S. Baird, Mamm. N. A. 423.

"ABROMYS LORDI. B. M.

"Fur soft, abundant, gray-washed, with blackish tips ; chin and under side of body whitish ; tail tapering, gray, with a blackish-brown upper surface and tip; hair of the back dark lead-color, with a short gray band and minute black tip.

"Perognathus monticolor [sic], Lord, in B. M.

"?Perognathus monticola, S. Baird, Mamm. N. A. 422, t. 51, f. 3 (skull).

"*Hab.* British Columbia (*Lord*).

"The teeth destroyed. Length of body and head 3 inches, of tail 3 inches. It differs from Dipodomys phillipsii and other species of that genus in having no white spot over the eye at the base of the ear, or white band across the thigh."

This account, dealing chiefly in vague generalities, and including a trivial comparison with an animal of a widely different genus, is worthless for all practical purposes. It would be well if the type could be re-described with reference to the points which afford distinctive characters in this group. We may suppose the animal to be a *Perognathus*, from the general tenor of Dr. Gray's remarks, and his curiously mixed up quotations; and it is perhaps *P. monticola*, as that species has conspicuously soft hair in comparison with some of its allies, and is of about the dimensions assigned.

Specimens of any Saccomyine form from Oregon and Washington Territory are at present special desiderata.

On the same page quoted, Dr. Gray describes a new species of *Perognathus* in the following terms:—

"PEROGNATHUS BICOLOR, B. M.

"*Perognathus monticola*, Gerrard, Cat. Bones B. M. (not Baird). Black; upper lip, lower edge of the cheek-pouch, head, and under side of body and inner side of limbs white. Fur uniform bristly; bristles elongate, slender, with a slender point, and intermixed with very slender elongated hairs. Tail as long as the body, with rings, square scales, and short bristly hairs.

"*Hab.* Honduras (*Sallé*).

"There is a Spiny Rat from Honduras[1] with a longer tail and smooth front teeth, agreeing in color with the above."

I have never seen a black and white *Perognathus*, nor one in which "bristles" were mixed with "slender elongated hairs;" but seeing the state of the fur in *P. hispidus* should not be surprised at any degree of rigidity the hairs of a species might develop further south.

A "*Perognathus fasciatus* Sallé" (nec auct.) is noticed by Gray (tom. cit.), p. 205, as a synonym of his *Heteromys irroratus*, n. sp. from Oaxaca. This is said to agree with the description of "H. [*i. e.* P.] fasciatus," but to have smooth upper incisors, etc. Gray calls the fur of *Heteromys* "flat channelled *spines*." There is nothing of this character in *Perognathus*, where the most rigid fur of any United States species would scarcely warrant the term "bristly." It is unexpected to find species of *Perognathus*, of two authors, quoted among the synomyms of *Heteromys*.

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[1] Characterized on p. 204 as *Heteromys melanoleucus*, with "Perognathus monticolor, [sic] Gerrard, B. M. not S. Baird," quoted as a synonym.

II. Genus **CRICETODIPUS** (Baird).

?*Cricetodipus*, Peale, U. S. Expl. Exped. 1848, 52. Type ——————?
= *Cricetodipus*, Baird, M. N. A. 1858, 418. Type *Perognathus flavus*. —Gray, P. Z. S. 1868, 202.

In treating of this form as a subgenus of *Perognathus*, Prof. Baird clearly showed its external peculiarities, namely, absence of lobation of the antitragus, hairy soles, and diminutive size; to these points are to be added the cranial peculiarities coincident with decidedly greater development of the mastoid than that seen in Perognathus. The points having already been given, it is needless to recapitulate them.

As noticed further on, the *Cricetodipus parvus* of Peale is an uncertain animal. In erecting *Cricetodipus* into a genus, I take *P. flavus* of Baird as the type, and follow this author in distinguishing a second species, which latter is probably, but not certainly, the *P. parvus* of Peale. The two appear to constantly differ in the following characters:—

Tail scarcely or not longer than the head and body; hind foot scarcely or not one-third as long as head and body. FLAVUS.

Tail decidedly longer than head and body; hind foot more than one-third as long as head and body. PARVUS (of Baird).

Cricetodipus flavus, Baird.

Perognathus flavus, Baird, Proc. Acad. Nat. Sci. Phila. 1855, 332. Baird, M. N. A. 1857, 423, pl. 8, f. 2, pl. 21, f. 3 *a–f* (assigned to Cricetodipus). Baird, P. R. R. Rep. x. 1859, Gunnison's and Beckwith's Route, Mamm. p. 8. Baird, U. S. Mex. B. Surv. ii. pt. ii. 1859, Mamm. p. Suckl., P. R. R. Rep. xii. pt. ii. 1860, 101 (Montana). Hayd., Trans. Am. Phil. Soc. xii. 1862, 147 (Loup Fork of Platte). Allen, Proc. Bost. Soc. N. H. xxii. 1874, 42 (Yellowstone R.).
Cricetodipus flavus, Gray, P. Z. S. 1868, 203 (compiled).

Diagn. Much smaller than Mus musculus; head and body two inches; tail the same; hind foot 0.65; ear small, not overtopping the fur, simple, without lobe of antitragus or tragus. Soles entirely hairy on the posterior half. Tail not decidedly longer than the head and body. Hind foot scarcely or not one-third as long as head and body. Above, pale buff, intimately blended with blackish; below, including whole fore leg, snowy white; sides with a clear buff stripe; tail obscurely bicolor; white touches often found about the ears.

Hab. Rocky Mountains of the United States and eastward in the Middle Faunal Province, from the British Possessions (lat. 49°, *Coues*) to Chihuahua, Mexico. (In the Pacific region replaced by *C. parvus.*)

Description (from numerous alcoholic and dry specimens, including Baird's types). In general points of exterior conformation this animal is so similar to species of *Perognathus* already fully treated, that the account of these features may be abridged. The generic character of structure of the ear and hairiness of the sole, with the diminutive size, are the chief points. The ear is very small and simple, not overtopping the fur of the parts. It is evenly rounded; there is no lobation whatever of either antitragus or tragus, the slight notch which exists being formed in front by the folded-over edge of the ear itself, and behind by the antitragal ridge. The head is full, especially in the frontal region, tapering to a bluntly conical snout, which is densely hairy excepting a minute nasal pad; the upper lip is heavily pilous with a fringe of hairs which droop over and hide the incisors. The eye is rather small, and nearer to the ear than to the nose. The whiskers are very numerous and fine, the longest exceeding the head. On the palms are observed posteriorly two great tubercles, of which the inner is much the largest; there are others at the base of the 2d and 5th, and of the conjoined 3d and 4th digits respectively; otherwise the palm is studded with minute granulations. The thumb is rudimentary, bearing a small flat nail; the other claws are of ordinary character; 3d longest; 4th little less; 2d shorter; 5th still shorter. The hairiness of the soles posteriorly is a generic character in comparison with *Perognathus;* anteriorly granular, with a small tubercle at the base of each digit, and another on the outer side of the metatarsus a little way up. The small size of the hind feet, however, is one of the most obvious distinctions from *C. Parvus.* The longest hind foot measured in upward of twenty cases is only 0.70 long, or barely one-third of the length of head and body, while the average is much below this, and the minimum is only about one-fourth of the length of the head and body. We may say simply that the foot is usually nearer one-fourth than one-third of this dimension. Similarly the shortness of the tail is a second character. In a large series, the vertebræ of the tail average just exactly as long as the head and body; in no case does the tail exceed the body and head by more than 0.25 of an inch, and this length is only exceptionally reached.

In most cases, any difference which may be observed is the other way, the tail being if anything a little shorter than the head and body. The tail, as in other species of this genus and of *Perognathus* (except *P. penicillatus*) is closely, but not very thickly, haired uniformly throughout; the terminal pencil is about a tenth of an inch long.

The pelage is extremely fine, soft, and glossy. The pictura is the same as in other species of this genus and *Perognathus*, namely, colored above with blended light and dark tints, white below, with a clear, single-color stripe along the sides. The upper parts are an intimate mixture of pale yellowish-buff with dark brown or blackish; the hairs are clear lead-color basally, then buff-ringed, then most of them dark-tipped. The resulting tone is nearly uniform over all the upper parts; but there are liable to appear whitish or tawny touches about the ears and eyes, and an appearance of a dark streak along the side of the head. The fawn-colored lateral stripe is uninterrupted from nose to heels; the tint is rather brighter than the buff of the upper parts, and pure, being not mixed with any dusky, and the color extending to the roots of the hairs. The entire under parts, including the whole fore leg, the hind feet, and inner side of hind leg are snowy white, the hairs having no basal color. The tail is obscurely bicolor; white below, and not very sharply colored above to correspond with the areas of the body.

Very young specimens, though nearly full grown and showing a sharp lateral streak, are more simply colored above than the adults, being grayish with extremely faint buffy lining, instead of sharply blackish and buff. There is also observable, in the series before me, a tendency to exhibit two different tones of coloration. Those from dry regions east of the mountains are mixed grayish-brown and grayish-buff, with the lateral pale buff stripe not very conspicuous. In New Mexico, southern Texas, and southward the animal frequently assumes a ruddier shade of the light color, mixed with much less blackish; in these, the lateral stripe is quite indistinct, because the upper parts in general are not very different. But the distinctions in these cases are not strong enough to require anything further than this notice of the fact.

The following table of measurements will illustrate the size and shape of the species very fairly, and to some extent expose the range of variation.

Measurements.

Current Number.	Locality.	Sex.	From tip of Nose to				Tail to end of		Length of		Nature of Specimen.
			Eye.	Ear.	Occip.	Tail.	Verteb.	Hairs.	Fore ft.	Hind ft.	
2615	Milk R., Mont........	..	0.40	0.75	0.95	2.25	2.15	....	0.30	0.70	Alc.
11666	Montana	..	....	....	....	....	....	....	....	0.70	Dry.
4331	Yellowstone.........	..	....	....	....	....	....	....	....	0.70	Dry.
3097	Black Hills..........	..	....	....	....	2.00	2.20	....	....	0.60	Dry.
2614	Ree Fork, "Neb." ...	..	0.45	0.80	0.95	2.40	2.20	....	0.30	0.65	Alc.
1931	Rupublican R. "Neb."	..	0.40	0.70	0.85	1.85	1.90	....	0.52	0.60	Alc.
3254	Loup Fork	..	....	....	....	....	....	....	....	0.63	Dry.
7340	" "	♀	....	....	....	2.20	2.30	....	....	0.65	Alc.
3050	Pole Creek...........	..	....	....	....	....	....	....	....	0.68	Dry.
4872	Fort Laramie........	♀	....	....	....	2.25	2.30	....	....	0.65	Alc.
7342	Ft. Bliss, N. M.......	♂	....	....	....	2.10	2.00	....	....	0.55	Alc.
270	Cimarron, N. M......	..	0.45	....	0.85	2.15	2.00	....	....	0.60	Dry.
......	Arizona	♀	....	....	....	1.80	2.00	....	....	0.60	Alc.
......	"	♂	....	....	....	1.90	1.90	....	....	0.60	Alc.
1041	El Paso, Tex.........	..	0.40	0.70	0.85	2.00	1.80	....	0.35	0.65	Alc.
1043	San Antonio, Tex	..	0.45	0.75	0.95	2.20	2.20	....	0.30	0.60	Alc.
2623	Chihuahua	..	0.40	0.70	0.85	1.85	1.60	....	0.25	0.55	Alc.
2613	Matamoras	..	0.45	0.80	0.95	2.15	2.40	....	0.35	0.65	Alc.
	Average	..	0.42	0.74	0.90	2.07	2.06	....	0.30	0.63	

Cricetodipus parvus, Baird (and Peal ?).

? *Cricetodipus parvus*, Peale, U. S. Expl. Exped. 1848, 53, "pl. 13, f. 2." Giebel, Säug. 1855, 600 (compiled from Peale). Gray, P. Z. S. 1868, 203 (compilation of doubtful references).

? *Perognathus* (*Cricetodipus*) *parvus*, Aud. and Bach., Q. N. A. III. 1854, 328 (copied from Peale).

Perognathus parvus, Baird, M. N. A. 1857, 425 (based on a specimen from King's R., Cal., doubtfully referred to C. parvus of Peale). Baird, P. R. R. Rep. X. 1859, Williamson's Route, p. 82 (same specimen).

Diagn. Quite like *C. flavus ;* tail and feet longer. Hind foot 0.70 or more, one-third or more as long as head and body. Tail decidedly longer than head and body—the vertebræ about 2.50 inches, to a body of 2.00.

Hab. United States west of the Rocky Mountains. California, Utah (and ?Oregon, *Peale*).

Of this supposed specie I have but a single specimen additional to the material in Prof. Baird's hands in 1857. This is alcoholic, in good preservation, and enables me to give the dimensions with accuracy.

No. 9856, Mus. S. I. ♀. Fort Tejon, Cala. *J. Xantus.* Nose to eye 0.45, to ear 0.70, to occiput 0.90, to tail 2.00; tail vertebræ 2.50, with hairs 2.75; fore foot 0.25; hind foot 0.70; ear above notch, 0.25.

A specimen from Utah (No. 439, Mus. S. I., formerly included by Baird under *C. flavus*) seems to rather belong to *C. parvus*; the hind feet are still longer—nearer 0.80 than 0.70—and the tail at least as long as in No. 9856.

As well as can be judged from the insufficient material before me, this species does not differ materially in color from *P. flavus;* and in fact the only diagnostic characters at present appreciable are the greater length of the hind feet and tail. There is, however, a decided difference in these respects. Further material will be required to confirm the specific distinctness here accorded, or to show that the two supposed species intergrade. Leaving this matter, we may turn to the history of the species, some points of which call for remarks.

In the first place, it is not certain that the animal called *parvus* by Baird in 1857, and by myself in the present instance, is really the *C. parvus* of Peale. Prof. Baird spoke somewhat guardedly in the matter, although he did not formally query his citations, as I have done, and I find myself equally in doubt. Nor do I see how the point is to be determined. For Peale's type, having been lost or mislaid, is not at hand to testify; and Peale's description, though elaborately detailed, will be found to consist entirely of supergeneric characters, shared by all the species of *Perognathus* and *Cricetodipus*, excepting the phrase "color above sepia-brown," which is applicable to none of the species known to me. The dimensions assigned agree exactly with those of the animal defined in this article; but they are equally applicable to a very young *Perognathus*. In fine, there is no *proof* that Peale's genus and species was not based upon a young *Perognathus*—possibly *monticola*. Therefore, while glad to concede that the probabilities are the other way, I think it safest to query the citation of Peale's animal and the compiled references that go with it; and I rest upon the *Perognathus parvus* of Baird, about which there is no uncertainty. LeConte's *P. parvus*, as I have already shown, is really based upon a very young example of *P. penicillatus*.

Baird's animal, from King's River, Cal., upon which the present account is entirely based, is very immature, as shown by the state of the teeth, though nearly or quite full grown. It curiously resembles a very young *P. penicillatus* (like LeConte's specimen for instance); and indeed, Prof. Baird was led, by its immaturity and defective state of preservation, to suggest that it might not improbably belong to *P. penicillatus*, though he proceeded to make it the basis of his *P. parvus*. It is, however, unquestionably a *Cricetodipus*, as I can affirm without qualification from inspection of the skull, which clearly shows the bulge of the mastoid back of an occipital emargination and other cranial characters diagnostic of *Cricetodipus*, to say nothing of the hairy soles and unlobed antitragus. I therefore accept the species as first clearly defined by Baird, without necessarily involving the question by including the doubtful animal of Peale.

As already suggested, the chances are that Baird was right in identifying his species with that of Peale, so that the name *Cricetodipus parvus* will stand. But should the contrary prove to be the case, and *Cricetodipus*, Peale, 1848, be conclusively shown to be a synonym of *Perognathus*, Maxim., 1839, a new name, generic and specific, will be required for the subject of the present article. The name *Otognosis* would be appropriate, in allusion to the facility with which the species may be distinguished from those of *Perognathus* by the structure of the ear. The present species may be called *O. longimembris*, as the length of the hind limbs and tail is its specific character in comparison with *O. flava*.

III. Genus **DIPODOMYS**, Gray.

Dipodomys, Gray, Ann. Mag. Nat. Hist. vii. 1840, 521, type *D. phillipii*.
Macrocolus, Wagner, Abh. K. Baier. Akad. xxii. 1845, type *M. halticus*.

A. *Generic Characters.*

Chars. (*a. cranial*). Skull light, thin, papery, depressed, broad behind with swollen curves, tapering in front; rostrum acuminate, produced beyond incisors; no interorbital constriction; palate plane; occipital surface deeply emarginate. Zygomata straight, thread-like, depressed to palatal plane; abutting against tympanics. Anteorbital foramina represented by a circular perforation of the front of the maxillaries. Large excavated lachrymals. Parietals triangular; an elongate interparietal embraced between forks of occipital. Squamosals reduced to small plates bounding the orbits posteriorly; other elements of the temporal bone extraordinarily developed, thin and bladdery, their sinuses of nearly as great capacity as the cerebral cavity; the mastoids especially enormous, constituting nearly all the occipital and the greater part of the superior (behind the parietals) surfaces of the skull;

the tympanics proportionally inflated, with large non-tubular orifice of meatus; the petrosals bullous, their apices in contact across the median line below the basisphenoid. Tympanics, mastoids, and parietals entering orbits. Occipital singularly reduced and narrowed, bent into three planes at right angles; supra-occipital bifurcate to inclose an interparietal; paroccipitals narrow, flange-like; basioccipital separated by a continuous fissure from petrosals. Mandible small, stout, with a very slight coronoid. (*b. dental.*) Superior incisors sulcate, connivent, pointing strongly backward; deeper than wide. Molars ($\frac{4}{4}$–$\frac{4}{4}$) simple, rootless. (*c. external.*) General form jerboa-like; hind legs very long, saltatorial. Tail rather longer than head and body, penicillate. Soles densely furry. Feet with 1st digit rudimentary, but bearing a claw. Eyes large and full; and ears large, orbicular. Snout produced, acute, pilous except a small nasal pad. Whiskers half as long as the whole body. Upper lip not cleft. Cheek pouches ample. Pelage long, and very soft. *Pictura* of body and tail bicolor. Size of a half-grown rat (*Mus decumanus*).

The skull of *Dipodomys*, whether taken as a whole or considered in several of its details, is of extraordinary characters not nearly matched outside the family to which it belongs. Many of its features are shared, to a greater or less extent, by *Perognathus;* but the unusual characters are pushed to an extreme in *Dipodomys*. The foregoing paragraphs merely indicate the more salient peculiarities; the skull is described in full beyond. The enormal development of certain elements of the temporal bone, and the results of this inflation upon the connections of the bone, and general configuration of the skull, are the leading characteristics. With this is co-ordinated the reduction of the squamosal and occipital, and the curious shape of the latter, as well as the anomalous abutment of the thread-like zygoma against the tympanic, and the contact of the petrosals with each other. In *Geomyidæ*, the temporals are of great size, but there is much less distortion of the topography of the parts, both squamosal and occipital maintaining ordinary characters. The temporal sinuses together are scarcely less capacious than the brain-cavity itself; the sense of hearing must be exquisitely acute, if co-ordinated with the osseous state of the parts.

Notwithstanding the singular condition of the skull of *Dipodomys*, resulting from the hypertrophy of certain parts, and the reduction of others, the relations with that of *Geomyidæ* are both close and clear; while *Perognathus* constitutes, in many respects, an excellent connecting link. Numerous coincidences could be pointed out, showing how the hint afforded by the presence in these two families of ample external cheek pouches is borne out in more essential features, notwithstanding the all but complete difference in general outward appearance.

B. *Cranial Characters of Dipodomys.*

As in other cases, it will be found most convenient to consider the skull as a whole first, and afterward to examine its individual bones. An immature specimen is preferable for the latter purpose, though many or most of the sutures persist to extreme old age.

In many respects, the skull of *Perognathus* approaches or closely resembles that of *Dipodomys*, but the family peculiarities reach their extreme development only in the latter. Comparative expressions used in the following paragraphs are to be considered exclusive of *Perognathus*, unless the contrary is stated.

The skull is much depressed; elongated and acuminate in front; very broad behind, where the width is nearly two-thirds of the total length; and, viewed from above, presents in general a triangular shape, with the lateral angles completely rounded off, and a deep emargination in the middle of the base. Zygomatic arches scarcely come into this view at all; the width of the skull midway being much less than the intermastoid diameter. The outline of the zygomata is perfectly straight; between the turgid mastoid region and the expanded plate-like zygomatic process of the maxillary there stretches the needle-like molar, depressed to the level of the palate. The outline of the orbits is a quadrate notch between the saliences just mentioned. There is no interorbital constriction; were it not for the laminar zygomatic expansion of the maxillaries and the bullous mastoids, the space between the orbits would be the broadest part of the skull. The attenuate acuminate rostrum springs directly opposite the broad zygomatic part of the maxillaries, and extends beyond the incisors; it is at least one-third of the total length of the skull. The postero-lateral aspects of the skull present enormous bulging masses rounded and somewhat ovate—the extraordinarily developed mastoids. The same swellings constitute also nearly all the occipital region, the median line of which is a deep emargination. This character is perhaps unique; nothing like it is seen even in *Perognathus;* its peculiarity is on a par with the immense rostral development in a walrus for example. The resulting figure, as one author has aptly remarked, bears a ludicrously close resemblance to the buttocks of the squatting human figure, the mastoids being the nates, the emargination being the cleft between, and the foramen magnum having an obvious suggestiveness. The whole surface of the skull is smooth, and gently convex in all directions. There are no ridges or roughnesses; the sutures persist plainly visible in adult life; and all the bones are remarkably thin and papery.

Viewed in profile, the skull shows notable features. The highest point is over the orbits, where the frontal and parietals are seen to be swollen; thence the superior outline sweeps gently down to the occiput, and in the other direction proceeds in a nearly straight—if anything slightly concave—line to the tip of the snout. The great projection of the nasals beyond the intermaxillaries is well shown. The incisors in profile are seen to curve far backward as well as downward. The palatal outline is nearly straight, and declivous from before backward. Behind the palate a small pterygoid hook is seen; but beyond this the whole outline is the inflated portions of the temporal bone hiding everything else. On the side of the rostrum midway, there is a large circular foramen, low down, but little above the palatal level; this is the orifice corresponding to the "anteorbital" foramen, here singularly displaced. From its fellow of the opposite side it is only separated by a very thin vertical septum, apparently ethmoidal. This delicate partition being often broken through in prepared skulls, has occasioned the statement of the inter-communication of the two foramina. But I find the septum complete and intact in some specimens, and although a vacuity may very possibly naturally occur, such does not appear to be the rule. The orbits appear as a subcircular fossa, largely roofed over in front by the thin expanded zygomatic plate of the maxillary, and bounded below by the molar. Independently of its laminar maxillary portion, the zygoma is a slender, straight thread down to the palatal level, and abutting behind against the tympanic. The actual suture is squamosal, as usual, but there is a curious appearance of connection with one of the otic bones. In the general inflation of the posterior portion of the skull appears the large orifice of the meatus auditorius—a simple circular opening in the bullous mass.

Viewed from below, the general contour is substantially the same as that already noted from above; but many special parts claim attention. So great is the backward obliquity of the incisors that their faces show in this view with comparatively little foreshortening. The incisive foramina are a pair of contracted slits midway between the incisors and molars. The palatal surface in advance of the molars is much compressed; that between these teeth is broader and quite flat; its width posteriorly is little less than its length: it contracts somewhat anteriorly, where it is marked by a median ridge continuous with the septum between the incisive foramina. That part of the palate constituted by the palatal bones is marked with several minute foramina. The palate ends behind with a sharp median spur; on either side of this is an emargination, and external to this a large fossa perforated with two foramina anteriorly, and a third and much larger one behind. Beyond the palatals themselves, the walls of the posterior nares are continued by the pterygoids, which are small and hamulate, the hook abutting against the petrosals. Between the ends of the pterygoids, and right across the middle line of the skull, the apices of the petrosals meet each other, forming a bridge beneath the basisphenoid. The posterior parts of the skull, behind those already considered, are almost entirely occupied by the inflated elements of the temporal bone, between which lies the reduced basioccipital; this bone is narrowly acuminate, and is separated from the petrosals for its whole length by a continuous fissure, like that which, on the other side of the petrosals, separates these bones from the alisphenoid and squamosal. The foramen magnum appears partly in this view, flanked by the slight condyles, outside of which are seen the small distinct flange-like paroccipitals.

The posterior view of the skull shows little but the inflated mastoids, with a cleft between, mostly occupied by the large foramen magnum, around which the contracted occipital bone appears as little more than the rim of this foramen.

All the bones of the skull, as well as those of the top already so described, are thin and light; and the base of the cranium is remarkable for its extensive vacuities. Not only are the petrosals separated from their surrounding by great fissures on either side, rendering it almost necessary to their stability that they should abut against each other at their extremities; but there is also a singular separation of the alveolar portion of the maxillaries from the superincumbent parts, by a horizontal fissure; so that the palate appears as a sort of bridge between the fore and aft parts of the skull. Various peculiarities will appear more clearly from the following descriptions of individual bones.

The complex temporal "bone" will be first considered, since the prime peculiarities of the skull result from the wholly singular condition of hypertrophy under which several of the elements of this bone exist. The topography of the parts, and the connections of the bone are curiously remodelled as a consequence of the enormous inflation of the various otic elements, and corresponding reduction of the squamosal. In the absence of investigations into the development of the temporal bone, I can only describe it as it appears in the adult animal, using the terms "mastoid," "petrosal," and "tympanic" in their current acceptation, without reference to the primitive otic elements. Respecting the squamosal there is no difficulty; the petrosal appears under its usual condition of a bulla ossea. I regard as "tympanic" the inflated vesicle in which the meatus auditorius is pierced, which appears as a tubular prolongation of the bulla in the nearest allied family, *Geomyidæ*. The rest of the inflation, forming the greater part of the occipital surface and much of the roof of the cerebral cavity, I shall simply designate as "mastoid."

The two temporal bones together are little less bulky than all the rest of the skull. Excepting the reduced squamosal, all the elements are subjected to extraordinary inflation, as well as peripheral enlargement; they appear as papery vesicles, light, thin, and smooth, without ridges or angles, inclosing extensive antra, the collective capacity of which is scarcely less than that of the whole brain-cavity. These vaulted walls are supported by delicate bony arches or trabeculæ within, and imperfectly partitioned into several cavities by thin septa. The mastoid constitutes the greater part of these bulging masses. Its backward protuberance occupies nearly all the occipital surface of the skull on each side, the occipital bone being reduced to a narrow margin of the foramen magnum, sunk in an emargination between the mastoid and its fellow. On the top of the skull the mastoid similarly expands, filling the whole of the area usually occupied by the squamosal, and forming the greater part of the roof of the brain-case. Thus we have the curious circumstances of extensive mastoideo-occipital suture on top of the skull, and still more prolonged mastoideo-parietal suture—for the whole of the longest side of the right-angled parietal articulates with the mastoid; while so great is the anterior prolongation of this same bone, that a small part of it fairly enters the orbit, at the back outer corner of the latter. This extensive line of sutures with squamosal, parietal, and occipital bones respectively is distinct throughout; but the boundaries of the mastoid with other otic elements can only be inferred by certain lines of impression which appear to mark it off from petrosal and tympanic. Another point is to be considered here: the flattened and entirely superior portion of the mastoid (that which lies in the ordinary site of a squamosal) is incompletely distinguished from the occipital portion of the same bone by a line of impression running straight across from the margin of the meatus auditorius to the median line of the skull; and this mark corresponds to a nearly complete bony wall within the bone, which partitions off one sinus from another. This may be hereafter found to indicate the respective parts which certain primitive otic elements take in the formation of the "mastoid."

The petrosal, *i. e.*, the bulla ossea, is less peculiar than the mastoid; it is not more inflated than in very many mammals, and is chiefly remarkable for its contact with its fellow, and for the extensive uninterrupted fissures which separate it both from basi-occipital and alisphenoid. In general shape it is conoidal, moderately swollen, with the apex of the cone produced and curiously curved toward the median line of the skull, where it meets its fellow, forming a bony bridge beneath the basisphenoid. The claw of the hamular pterygoid rests against the end of the petrosal; and close to this there is an abutment of a piece of the sphenoid; otherwise, there is a great fissure betwixt it and the sphenoid. It is only in contact with occipital elements by means of the flange-like exoccipitals; the whole extent of the basioccipital being separated, as just said, by a large fissure. Posteriorly it is confluent with the mastoid, with imperfect indication of the precise line of union; exteriorly it is continuous, without appreciable indication of original distinction, with the special inflation in which the meatus is situated. This papery vestibule I presume to be analogous with the tubular meatus externus in *Geomyidæ* and elsewhere; the orifice is large, subcircular, and simply a hole without raised brim, pierced in the back upper corner of the bulb. Anteriorly the tympanic bulges so far as to form part of the orbit. While this special inflation is not otherwise distinguished from the general bulla ossea than by a slight constriction, it is remarkably divided off, above and behind, from the mastoid, by a strong line of impression, of which I shall say more presently.

Coincidently with the hypertrophy of these otic elements of the temporal, the squamosal is peculiarly reduced in extent, and pushed into the orbit, to which it is almost entirely restricted. It is simply a small irregularly shaped plate of bone lining the back part of the orbit, with a slight spur just exceeding the orbital brim in a little notch between corners of the frontal and parietal bones. The squamosal remains long discrete from all its surroundings. In full-grown though youngish animals the squamo-sphenoidal sutures may be readily traced—that with the alisphenoid just below the glenoid cavity, that with orbito-sphenoid within the orbit. The zygomatic process of the squamosal is of peculiar character: instead of a slender curved spur reaching around to grasp the malar, there is a short abrupt heel appressed against the tympanic, and to the roughened face of this heel the clubbed end of the needle-like malar is affixed. The relation of the parts is such that the zygoma appears to articulate behind with the tympanic—it actually has an abutment against that bone, though no real articulation with it.

From the lower back edge of the squamosal a curious thread of bone starts off and occupies the deep groove already mentioned as separating the tympanic from the mastoid. No break from the squamosal can be seen in this thread, which curls around the orifice of the meatus, still in the groove mentioned, and ends by a slightly enlarged extremity below and behind the meatus, exactly in the position of an ordinary "mastoid process." I am uncertain of the meaning of this. The end of this ligule or girdle of bone thus encircling the tympanic is in the site of the postero-lateral angle of the skull in *Geomyidæ*, in which such angle is formed by a corner of the squamosal; and the inference is self-suggestive that this delicate bony strap may really be squamosal—an edge of the squamosal persisting in situ after the rest of that bone has been crowded down into the orbit by the encroachment of the mastoid. Such a view, however, will bear further scrutiny. Even if a slender spur of actual squamosal does run out into the tympano-mastoid groove, it does not follow that the whole of the fold in this groove is squamosal; and certainly the enlarged extremity of this ridge, behind the meatus, has every appearence of an ordinary mastoid process.

Next after the squamosal, the occipital bone suffers most from the enlargement of the otic elements; it is singularly restricted in extent, and presents itself in unique shape, compressed between the swollen mastoids. All the lateral occipital suturation is with the mastoid, excepting the basioccipital. The occipital lies in three planes, nearly at right angles with each other. The basioccipital is horizontal, as usual upon the floor of the skull; the exoccipitals, with probably part of the supraoccipital, are perpendicular, behind; the rest of the supraoccipital is horizontal again, on top of the skull. The basioccipital is wedge-shaped, and offers nothing very peculiar, excepting its entire disconnection from the petrosals between which it lies; its sphenoidal articulation is just behind the joined apices of the petrosals. Exoccipitals appear as a pair of flaring flange-like processes, just outside the condyles, appressed against the otic capsules. The foramen is very large, subcircular, and mostly in the perpendicular plane of the bone. After inclosing this orifice, the bone rapidly contracts as it rises to the top of the skull; this part is marked with a sharp perpendicular median ridge, and the edges of the bone being affected in coming into apposition with the swelling mastoids, there results a pair of deep narrow fossæ upon the face of the bone. The portion of the supraoccipital which mounts the top of the skull to there lie horizontal, almost immediately forks to embrace a small shield-shaped interparietal bone between its prongs. The ends of these prongs touch posterior corners of the parietals

The sphenoid bone is of rather small extent, owing to the situation of the squamosals in the orbit. It is widely fissured from the petrosals. The alisphenoid is very short; its termination may be seen in the jagged suture with the squamosal; but short as it is, it only misses taking part in the mandibular articulation, since it extends to the margin of the glenoid. The orbito-sphenoid is comparatively smaller still, the place it occupies in *Geomyidæ* for instance being here largely occupied by the squamosal. The spheno-palatal suture may be traced in young specimens with a zigzag but still in general transverse course, from the side a little behind the maxillary alveolus across the middle line of the skull. There is no vertical orbital plate of the palatal bone; it all lies flat, and extends forward on the palate, wedge-shaped, but with square termination to a point opposite the first true molar. A backward spur of this bone forms with its fellow a sharp median process. There are various foramina already noted. The pterygoids are small claw-hammers abutting at their extremity against the petrosals.

The parietals are nearly right-angled triangles, with one side of mutual apposition along the median line of the skull, another transversely articulating with the frontal, and the hypothenuse postero-exterior, for the mastoid suture. The back corners meet the prongs of the occipital and slightly embrace the interparietal. The outer corner is prolonged into a spur which attains the brim of the orbit. And here the remarkable construction of the orbit by an unusual number of bones, may be noted. Following the brim of the orbit around we find—zygomatic process of maxillary; lachrymal; frontal; spur of parietal; back upper corner of squamosal; front end of mastoid; fore bulge of tympanic; zygomatic heel of squamosal; whole of malar, and so back to maxillary.

The portion of the frontal which appears on the surface of the skull is keystone-shaped and straight, broad behind to articulate with both parietals, narrowing anteriorly with nearly straight edge, and in front irregularly tranverse to accommodate its several rostral sutures. It sends a sharp spur on either hand into a recess between the maxillary and intermaxillary, and each intermaxillary causes a shorter, more obtuse re-entrance; the middle part articulating with the nasals is tranverse. The orbital portion of the frontal is a simple plate suturing behind with the orbito-sphenoid and squamosal, and in front with maxillary and lachrymal. The latter is of considerable extent, and much excavated; its edge appears upon the surface of the skull, margining the back of the zygomatic process of the maxillary.

The malar is very peculiar. In allied rodents, this bone is a stout arch, and very short, in consequence of the close approximation of the ends of the zygomatic processes of both maxillary and squamosal. But here there is, to all intents, no such squamosal process, and that of the maxillary ends abruptly: so the malar is a long bone, to complete the arch; it is a straight rod, of thread-like tenuity, with the fore end slightly elbowed and sharpened to lie by oblique suture against the maxillary, on the inner side, and the hind end slightly clubbed to suture by a roughened flat surface with the heel of the squamosal; and such are the relations of the parts, that the malar seems to run against the otic capsule. The depressed position of this bone, which lies down on the level of the palate, has been already noticed.

The maxillary bone, with a general shape and connections which scarcely require notice, has two peculiarities; one of these is the singular position of the "ante-orbital" foramen;—here a large circular perforation at the anterior border of the side of the bone, altogether remote from the orbit. It lies above and even in advance of the incisive foramina. Its fellow is only separated by the width of the compressed muzzle; there is a thin partition, probably ethmoidal, between them. The other peculiarity of the mastoid is the unusually extended and vaulted zygomatic plate, which thus roofs over a considerable part of the orbit. This inflated lamina suddenly comes to a point where the malar joins it. Its suture with the frontal, or the surface of the skull, is a straight line.

The incisive foramina, in *Geomyidæ*, are wholly in the intermaxillaries; in *Dipodomys* they are formed by both bones, the maxillaries bounding about a third of their periphery. The nasal spur of the intermaxillary extends upon the forehead a little way beyond the ends of the nasals; while a sharp process of the frontal separates it from the maxillary. The alveolar portion is remarkably curved backward, to suit the trend of the incisors, and a strong alveolar plate separates the teeth for about half their length.

The nasals are chiefly notable for their length and tenuity; they reach far beyond the incisors; the back half is linear and superficial; anterior to this, where the intermaxillaries bend down, they become somewhat volute, prolonging a semi-tubular snout. Within, delicate turbinal scrolls are seen extending to the orifice. The nasals are supported, nearly to their ends, by small intermaxillary spurs.

The mandible remains for consideration. This bone is remarkably small, considering the size of the rest of the skull, and is further notable for its slight elevation posteriorly, its short incompleted symphysis, and the thickness of the body of the bone. The coronoid process is remarkably small, not nearly attaining the level of the condyle, at the root of which it appears as a minute backward sloping prickle-like spur. The condyloid ramus itself is small, compressed and oblique. The principal feature of the bone is an immense flaring lamina which arises as a verge upon the back part of the lower border of the body of the bone, and expands obliquely outward and upward, with a peculiar twist. This plate-like process is longer than the condyloid ramus itself, and ends in an acute point, so that the back of the jaw appears two-pronged. There is a deep pit between the alveolus and the root of the coronoid plate. The mental foramen is conspicuous upon the outside of the jaw close to the incisors. The small size and lowness of the jaw is seen in the peculiarly retreating chin of the species; and it is probable, especially to judge from the condition of the coronoid, that the biting power is comparatively slight.

The vertebral formula of *Dipodomys ordii* is given by Baird as 7 cervical (with anchyloses of 2d, 3d, and 4th), 12 dorsal, 9 lumbar, 4 sacral, and 28 caudal, = 60; there is doubtless an individual variability of several of the caudal segments. There are five metacarpals and metatarsals, though the inner one of each is reduced. There are perfect clavicles. The tibia and fibula are united below.

C. *Dental Characters of Dipodomys.*

The dentition of Dipodomys is simple. Of the four molar teeth above and below, the anterior one is a premolar, being preceded by a deciduous tooth, which, however, is long persistent. This one is rooted and with a more complicated crown than the rest; the molars proper are rootless and perennial. In both jaws, the set of the molars is very oblique; in the upper, the anterior tooth bends strongly backward, and the posterior one somewhat forward; thus bringing their crowns in close apposition, though their roots are divergent. It is the same in the lower jaw, though the greatest obliquity there is in the strong forward set of the posterior tooth. The teeth are all simple compressed prisms, broader in the transverse than in the fore and aft direction. In the worn state, the crowns of the two intermediate molars are simply elliptical; that of the anterior molar is rather a spherical triangle, with convex posterior, and two concave anterior sides; the back molar is small and subcircular. It is much the same in the lower jaw. The crowns show simply the brim of enamel, with a depressed island of dentine. In the unworn state, however—such as may be observed in specimens with the milk tooth still in position—there are some decided differences. The outer border of the two anterior teeth shows a deep nick, where there is a reëntrant fold of the enamel; and the back molar has a similar indentation of the inner side. This diminishes regularly with the continuous growth of the incisors, until the crowns are ground down beyond the extent of the infolding, when it ceases to appear and the plain elliptical form of the crown is assumed.

The incisors are small and delicate, in both jaws, contrasting with the stout scalpels of *Geomyidæ.* The superior pair are much compressed, being narrower than deep, and strongly curved. Their face is marked by a deep median groove, and the outer portion is rabbeted away, so that the groove is visible in a profile view. The teeth emerge from the sockets some distance apart, separated by an intervening alveolar plate, but they are convergent, and their tips are in close contact. The under incisors, no larger than the upper ones, are of much the same general character, but are not grooved, the smooth faces being simply rounded off. Their roots make a slight protuberance at the outside of the base of the condyloid ramus.

D. *External Characters of Dipodomys.*

The general configuration of this animal is lithe and graceful, indicating agility and incessant activity. The body is slender, the neck distinct; the head large with tapering muzzle; the eyes and ears are prominent; the fore limbs small and neat, indicating predominance of prehensile over merely gressorial faculties; the hinder limbs are of great size, as perfectly saltatorial as those of a kangaroo or jerboa; and the tail is longer than the body. Notwithstanding the saltatorial nature of the animal, there is none of that preponderance of organization of the hinder parts witnessed in the kangaroo, with its massive haunches and enormous tail; the whole body is equally slender, the leaping power being manifested in the enlargement of the hind limbs alone; the tail, too, is slender throughout.

The head is distinguished from the body by a well-defined cervical constriction. The broad high occipital region dips suddenly down to the nape. The upper corners of the head, upon which the ears rest, are elevated and wide apart; the top of the head has in general a triangular shape, tapering from each ear to the snout with but slight swelling in the orbital region, and is quite flat across, with the most gentle longitudinal curve in the frontal region, and nearly straight nasal profile. The muzzle is acuminate, and much produced, appearing longer still in consequence of the remarkably small retreating chin. The muzzle is entirely hairy, excepting a small nasal pad; this shows a median depression, but there is no cleft of the upper lip, the whole of which is thickly clothed with stout hairs, that form a dense fringe drooping over and concealing the superior incisors. The lower lip is thickened and densely hairy; and there is also a hairy commissure of the upper lip *behind* the superior incisors, so that these teeth are shut out of the true (mucous-lined) buccal cavity. For the rest, the lips seem to come together vertically instead of horizontally, closing the oral aperture sideways, though of course the buccal cavity or mouth proper shuts as in ordinary mammals. All this is essentially the same as in the *Geomyidæ;* and further, as in these last, there is a great pouch on each side of the head, entirely disconnected with the mouth, formed of a duplication of ordinary integument, hairy throughout. These sacs will admit the first joint of one's little finger; they run the whole length of the head, but not beyond to the shoulder. In relative capacity, they about equal the least developed pouches of *Geomyidæ*—those of *G. hispidus* for instance. The opening is crescentic; the inner limb of the semilune being the skin of the jaws, while the outer limb is a free fold or border arising on the side of the snout half way between nostrils and incisors and a little back of both, and curving loosely around to the side of the under jaw near its middle.

The whiskers are extremely numerous, and some of them are very long. A bunch of short fine ones springs from the extremity of the snout, on each side, by insensible lengthening of the fringe of hairs that clothe the upper lip. Others grow in the usual site, and the longest of these usually exceed half the total length of the body. There are other long slender bristly hairs in weak clumps about the eyes and ears, and a bunch of short antrorse bristles springs from the chin. The eyes are large and prominent, in life remarkably soft and expressive, in striking contrast to the little piggish peepers of the *Geomyidæ;* in consequence of the production of the muzzle, they are situate much nearer to the ears than to the nose, and rather above a line connecting the two. The ears, similarly, are large and "leafy," appearing the more prominently because they rest upon the most protuberant part of the skull. When pressed out flat, the auricle is nearly orbicular. In the natural state, the fore border is largely folded over, the duplication extending from the extreme root to the highest point of the ear, and representing about one-third of the width of the ear. This fold causes a slight pointing of the ear. The posterior border is more rounded than the anterior; and within its base is developed a large conspicuous obtusely angular antitragus, so broad that its inner edge is extensively overlapped by the fold of the anterior border of the auricle. A fringe of long hairs springing from the base of the anterior fold is directed backwards over the antitragus; otherwise the auricle is closely and completely pilous on both sides, the hairy clothing of the open part of the concavity being heavier than that on the back of the ear.

The fore limbs are shortened, in sacrifice of locomotive ability to increase of prehensile faculty. The arm and forearm are stout; the latter tapers very abruptly and contracts to a delicate wrist and very small hand. There are four perfect digits, and a rudimentary thumb; the longer digits rather exceed, even excluding their claws, the length of the hand proper (metacarpus); the 3d and 4th are approximately equal in length and longest; the 2d and 5th are successively reduced a little in length; the 1st is a mere stump; its claw a knob; the other claws are well formed, slender, compressed, acute, little curved, nearly as long as their respective digits. The back of the whole hand is pilous, and longer hairs fringe the sides of the digits; but the palm is naked, minutely tubercular throughout, these numberless little elevations showing no recognizable special distribution. The hand ends behind with an enormous smooth bulb, a little to the inner side, and with a smaller external bulb, likewise smooth, separated from the main one by a hairy isthmus.

The hinder limbs offer the opposite degree of development. While the fore, from the elbow outward, is only a fourth of the total length, the corresponding measurement of the hind limb, that is, from the knee outward, is three-fifths or more of the whole length, and the hind foot alone is about one-third of such dimension. There is no noticeable bulkiness of the haunches, but the hams are massive, flattened-conoidal, suddenly contracting at the lower third, where the crus is of much less calibre than the foot. There is a prominent heel, and obvious tendo Achillis. The metatarsus is subcylindrical, widening to a broad foot with strong digits. The whole foot reminds one of a rabbit's; a resemblance heightened by the dense furring of the whole sole, excepting a small calcaneal tuberosity. There are four perfect digits, of which the 3d is the longest, the 4th and 2d are successively a little shorter, and the 5th is much shorter still; while the 1st is a mere rudiment, entirely removed from the rest, nearly half way up the foot. This bears a stumpy claw; the other claws, though small, are well formed, stout at base, compressed, little curved, and acute.

The tail exceeds the head and body in length, even without the penicillate tuft of hairs at the end, which projects an inch or more beyond the vertebræ. It is of somewhat quadrangular shape, the flattening being especially appreciable on the under side, and is of nearly uniform calibre throughout, springing directly from the body without any basal enlargement, and but little taper at the end. It is closely and uniformly clothed with rather stiffish hairs for most of its length, the hairs gradually lengthening on the further half into the well-formed terminal brush.

The pelage differs from that of the allied genus *Perognathus* in its softness, length, and fineness, and has a silky gloss in life. It also lies with extreme smoothness on the colored areas of the body; the hairs are plumbeous basally, as usual; on the white parts they are unicolor to the roots.

In the male, during the rutting season, there is an immense perinæal enlargement, strictly circumscribed from neighboring parts, due to the turgidity of the virile organs within. The anus presents in the centre of this enlargement with the sheath of the penis just in front, quite prominent. There is a comparatively large os penis. In the female the anal and genital orifices are in still closer relation; the ostium vaginæ is prolonged in front into a dependent lobe, occupying the site of the penial sheath of the male.

The pattern of coloration of *Dipodomys* is peculiar and diagnostic of the genus—the striped tail and white band across the hips are not found elsewhere. All the upper parts are fulvous or tawny brown, closely lined with fuscous to a greater or less extent and intensity. Some specimens, with the least dusky, are very light colored—a pale yellowish cinnamon; others approach mouse color, but even in the darkest specimens the decided fulvous shade appears at least upon the sides. All this colored portion is plumbeous beneath, excepting a little space along the middle of the sides, where basally white hairs have the tawny tips. All the under surface of the animal is snow-white to the roots of the hairs. The line of white begins on the side of the muzzle and runs along the side of the head, including the pouch; the entire fore limb is white; the stripe rises a little on the side of the belly, and thence runs along the middle of the outside of the hind limb from the knee to the heel, sending a sharp white stripe from the knee across the haunches to the root of the tail. The hind foot is white, with a dusky stripe along the sole. The whiskers are partly black, partly colorless; their conjoined bases make a conspicuous black spot on each side of the muzzle. There is some whitishness in most cases—sometimes altogether wanting—about the eye, and a white patch just back of the ear. The front of the ear is sometimes light. The tail is dusky-slaty, or sooty-brown, or even blackish, with a broad, firm white stripe on each side from base to near the tip. At the extreme base, the white usually encircles the tail; at the other end, the color of the tuft is altogether indeterminate; sometimes the white lateral stripes give out before reaching the end, leaving the tip entirely dark; sometimes the white extends to the very end of the brush, cutting off the dark altogether; and moreover, the white may encroach upon the under side, cutting off the dark from more than half the tail; oftener, the brush is mixed dusky and white. Thus the tail may end either white or dark, or a mixture of both. It is as variable in this respect as the tail of a skunk. The eyes are lustrous black; the nose pad and palms flesh colored; the claws pale.

In old museum specimens, long exposed to the light, the above description may not be verifiable as regards any of the darker markings and shades mentioned; for all the colored portions of the fur finally fade to a dull, pale brownish-yellow, or even dingy yellowish-white. Under such circumstances, even the rich purplish chestnut of a mink, for example, ends in dingy whitish.

Having thus fully exposed the general characters of the animals of this genus, it remains to consider the mode in which and extent to which the genus has become differentiated into recognizable forms, if there be more than one. Various species have been proposed and recognized. As these rest mainly upon size and proportions, these points will be first discussed.

The following tables of measurements of a series of *Dipodomys*, fresh and alcoholic, will serve to show whether or not the two species, commonly supposed to be distinguished by size and proportions, intergrade in these respects. The specimens are arranged without reference to locality, according to the chief point in question, namely, length of tail.

Measurements.

Current Number.	Locality.	Sex	From tip of Nose to				Tail to end of		L'gth of		Nature of Specimen.
			Eye.	Ear.	Occip.	Tail.	Verteb.	Hairs.	Fore ft.	Hind ft.	
4970	Cape St. Lucas........	♂	0.90	1.45	1.55	3.50	5.00	....	....	1.35	Alc.
8436	Ft. Whipple, Ariz	♂	....	....	1.90	4.25	5.00	6 00	....	1.55	Fresh.
4871	Cimarron, N. M......	♀	1.00	1.55	1.75	4.50	5.00	5.75	....	1.55	Alc.
4970	Cape St. Lucas........	♀	0.85	1.35	1.45	3.50	5.25	....	....	1.40	"
8437	Ft. Whipple, Ariz	♂	....	....	....	4.50	5.25	6.25	....	1.50	Fresh.
9478	(Unknown)...........	♂	1.00	1.40	1.55	4.75	5.50	....	....	1.60	Alc.
4970	Cape St. Lucas........	♀	0.85	1.40	1.50	3 75	5.75	6.75	....	1.40	"
4970	" "	♂	0.95	1.50	1.60	3.75	5 75	6.75	....	1.40	"
4970	" "	♂	0.90	1.45	1.55	3.75	5.75	6.75	....	1.45	"
7349	(Unknown)...........	..	....	....	....	....	5.75	6.50	....	1.60	"
7344	Platte Valley.........	♀	0.90	1.40	1.60	4.50	5.75	7.00	....	1.55	"
2627	Ft. Reading, Cal......	♂	0.90	1.35	1.55	3.35	5.80	....	....	1.60	"
2626	" "	♂	0.80	1.25	1.40	3.25	6.00	....	....	1.60	"
2628	"California".........	..	....	....	....	5 00	6.10	7.00	....	1.60	"
10725	Monterey.............	♂	1.00	1.60	1.75	5 09	6.75	7.75	....	1.70	"
7348	Ft. Tejon, Cal........	♀	1.00	1.60	1.80	4.25	7 00	7 75	....	1.70	"
....	"Rocky Mts."........	♀	0.95	1.45	1.70	4.50	7.00	8.00	....	1.70	"
....	Average	..	0.92	1.44	1.61	4.06	5.79	6.85	....	1.58	"

The foregoing table of measurements of only 17 specimens, all adult, suffices to prove an uninterrupted gradation in size of every part of the body and its members. There is no break whatever in any of the absolute dimensions. The specimens range, by minute fractions of the inch, from 3.25 to 5.00 inches in length of head and body, averaging about 4.00. The tail vertebræ range from 5.00 to 7.00 inches, averaging about 5.75; with the hairs the tail is from 5.75 to 8.00 inches, averaging a little less than 7.00. The hind foot runs from 1.35 to 1.70, settling at an average of 1.58. It will be observed that the lengths of tail and feet bear no constant ratio to each other, some specimens with relatively smallest feet having relatively the longest tails. It will further be evident that absolute lengths of tail and feet are not indicative of geographical limitations; for the specimens which are arranged in the table with reference to absolute length of tail-vertebræ (with which absolute length of feet is approximately correspondent) show complete intermixture of localities. Measurements of a hundred or a thousand specimens would of course only tend to place these facts in stronger light. It may be safely stated as a fact, then, that differences in absolute size, either of the body or of any of its members, are not available for distinction of two species; and furthermore, that no set of absolute dimensions is correlated with geographical distribution.

Nevertheless, one cannot fail to be struck, in examining the table, with the extraordinary discrepancy in *relative* length of the body and tail. In No. 4871, for example, the tail (vertebræ) is only half an inch longer than the head and body (4.50–5.00); that is to say, it is but *one-ninth* of the head and body length longer. In No. 2626 the tail is two and three-quarter inches longer than the head and body; that is to say, almost *twice* as long. It would appear improbable that such unusual difference as this should not signify something more than mere individual variability. In order to discover whether or not the *proportionate* (as distinguished from absolute) dimensions of body and tail may not lead to some tangible result, the following table is constructed, in which the same specimens are arranged geographically. It is necessary to exclude four of them however (Nos. 9478, 7349), from unknown localities, together with the two respectively marked "California" and "Rocky Mts.," as I have reason to believe that these indications of locality are not reliable.

Measurements.

Rocky Mountain Region.				Coast Region.			
	Head and body.	Tail Vert.	Hind foot.		Head and body.	Tail Vert.	Hind foot.
Arizona	4.25	5.00	1.55	Capt. St. Lucas	3.50	5.00	1.35
"	4.50	5.25	1.50	" "	3.50	5.25	1.40
New Mexico	4.50	5.00	1.55	" "	3.75	5.75	1.40
Platte Valley	4.50	5.75	1.55	" "	3.75	5.75	1.40
				" "	3.75	5.75	1.45
				Ft. Reading	3.35	5.80	1.60
				"	3.25	6.00	1.60
				Monterey	5.00	6.75	1.70
				Ft. Tejon	4.25	7.00	1.70
Averages	4.43	5.25	1.53		3.78	5.89	1.51

This second table, as far as it goes, leads to some tangible and practical results. More specimens would undoubtedly modify the exact figures, but would, I think, only confirm the general statement, that there is a decided difference in relative length of head and body and of tail, between specimens from the interior and those from the coast region. This substantiates, in effect, the broad distinction established by Baird in 1857, though the details given by that author require qualification.[1]

In the animals from the interior, with an average length of nearly 4.50 inches, the tail is scarcely or not an inch longer than the body; that is to say, it is about one-fourth as long again as the head and body.

In the coast region specimens, with an average length of less than 4 inches, the tail is about two inches longer than the head and body; that is to say, it is if anything more than half as long again as the body.

The feet do not present any very tangible characters. We find them of all sizes coupled with different extremes of tail length. Nevertheless it will be observed that the Cape St. Lucas specimens alone of the coast series present small feet, under 1.50; and that without these, the coast series would show a length of foot of 1.60–1.70, thus correlated with the greater length of tail.

To these data may be added some others, tending to substantiate the differentiation of the forms of the genus. The western animal averages smaller, and of more slender build, with larger ears, and longer limbs, and especially longer tail. It is darker in color, the prevailing tone being a mouse-brown overcast with tawny or fulvous. The animal from the interior is larger, and noticeably more stoutly built, with smaller ears, and shorter limbs, and particularly shorter tail. It is lighter in color, the prevailing tone being the peculiar tawny or fulvous of the genus, deepened somewhat on a dorsal area with mouse-brown.

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[1] M. N. A. 1858, p. 409.—"Whatever the number of species, all hitherto detected in North America belong to the two following sections:—

"Section I. Hind foot not exceeding 1.50 inches, usually appreciably less; about one-third the length of head and body. Tail vertebræ about 1¼ times the length of head and body in nature; rarely exceeding 5 inches, never 5¼. *D. ordii.*

"Section II. Hind foot, 1.60 inches, sometimes more; always considerably exceeding 1.50; almost half as long as head and body in the first specimens. Tail vertebræ 1¾ times the length of head and body, always exceeding 5¼ inches; usually from 6 to 7 inches. *D. phillippi*, *D. agilis.*"

The proportions of body and tail here laid down I verify exactly, though the limits of extremes given require to be enlarged. On the contrary, the statements made respecting the feet do not hold upon examination of more material. In fact the Cape St. Lucas are the shortest-footed animals of the whole series: and in one very large Texas specimen (dry), not given in the table, the foot is almost 2 inches long.

These are simply observed matters of fact, not open to question. Certain differences which actually exist, as well as the insensible blending of these differences, may both be fairly signalized by the following formulæ of nomenclature and description, in which the various names which have been proposed are relegated to their proper place, covering diagnosis of typical (*i. e.* extreme) characters, and indication of the region in which such form more especially prevails:—

Dipodomys phillipsi,[1] Gray.

Dipodomys phillippii, Gray, Rep. Brit. Assoc. 1841, 70; Ann. Mag. N. H. vii. 1841, 521. Real de Monte, Mex. (Type of genus.)—Gray, Am. Journ. Sci. xlii. 1842, 335.—Wagn., Suppl. Schreb. iii. 1843, 295.—Le C., Proc. Acad. Nat. Sci. Phila. vi. 1853, 224. (Sacramento Valley, Cala.)—Gieb., Säug. 1855, 600. (Compiled.)—Baird, M. N. A. 1857, 442. (California, etc.)—Coop. and Suckl., P. R. R. Rep. xii. 1859, Mamm. pp. 100, 127.

Dipodomys philippi, Schinz., Syn. Mamm. ii. 1845, 93. (Compiled from Gray.)

Dipodomys phillippsii, Aud. and Bach., Q. N. A. iii. 1853, 137, pl. 130. (From Gray's type.)

Dipodomys phillipsii, Gray, List. Mamm. Br. Mus. 1843, 120.—Gerr., Cat. Bones Br. Mus. 1862, 173.—Gray, Proc. Zool. Soc. 1868, 200.

Dipodomys phillippii, Baird, P. R. R. Rep. x., 1859, Williamson's Route, Mamm. p. 82.

Macrocolus halticus, Wagn., Abh. K. Baier. Akad. xxii. 1845, 319; Arch. f. Naturg. 1846, 172.—Giebel, Säug. 1855, 599. (Compiled.)

Dipodomys agilis, Gamb., Proc. Acad. Nat. Sci. Phila. iv. 1848, 77. (Los Angeles.)—Le C., Proc. Acad. Nat. Sci. Phila. vi. 1853, 224.—A. and B., Q. N. A. iii. 1854, 339. (Compiled).—Gieb., Säug. 1855, 600. (Compiled.)—Bd., Proc. Acad. Nat. Sci. Phila. 1855, 334 (San Diego); M. N. A. 1857, 414, pl. 9, f. 1.—Gray, P. Z. S. 1868, 201.

Dipodomys heermanni, Le C., Proc. Acad. Nat. Sci. Phila. 1853, 224. (Sierra Nevada.)

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[1] This name is found variously spelled by authors, as well as by Gray himself; but if, as stated by Gray, the species was named after John Phillips, the rendition here adopted appears to be most correct.

Dipodomys heermannii, Baird, M. N. A., 1857, 415. (Compiled.)
Dipodomys hermannii, Gray, P. Z. S. 1868, 201. (Compiled.)
Dipodomys wagneri,[1] Le C., Proc. Acad. Nat. Sci. Phila. 1853, 224.—Bd., M. N. A. 1857, 415. (Compiled.)—Gray, P. Z. S. 1868, 201. (Compiled.)

Hab. Pacific region at large, from Washington Territory to Cape St. Lucas; Nevada; and portions of Mexico (Real del Monte, *Phillips*). Specimens examined from Fort Walla-Walla, Cape St. Lucas, and numerous localities nearly throughout Upper and Lower California.

Chars. Small: rather under than over four inches in length of head and body, with slender shape, large ears, long limbs, and especially long tail. Tail vertebræ 2 inches (more or less) longer than the head and body, bearing a proportion of about (rather more than less) 1.50 to 1.00. Coloration heavy: upper parts rather dark mouse-brown or even dusky in general tone, lightened, especially on the sides, with the peculiar tawny shade of the genus.

This animal served as the type of the genus, described by Gray in 1840. It figures in various treatises, mainly under compilation. Audubon gave an excellent illustration, taken from the type specimen. *Macrocolus halticus* of Wagner, described soon afterward, is, as suggested by both Gray and Baird, undoubtedly the same animal, though no mention is made of the pouches. Some other unquestionable synonyms are cited above.

Dipodomys phillipsi ordi, Woodh.

Dipodomys ordii, "Woodh.," LeC., Proc. Acad. Nat. Sci. Phila. vi. 1853, 224. (Notice of Woodhouse's type).—Woodh., Proc. Acad. Nat. Sci. Phila. vi. 1853, 235; Sitgr. Rep. Expl. Zuñi and Col. R. 1853, 50, pl. 4. (El Paso, Texas.)—Aud. and Bach., Q. N. A. iii. 1854, 317. (Compiled.)—Baird, M. N. A. 1857, 410, pl. 5, f. 1; pl. 21, f. 1; pl. 51, f. 1, 2.—Baird, P. R. R. Rep. x. 1859, Gunnison's and Beckwith's Route, Mamm., p. 8.—Baird, P. R. R. Rep. x. 1859, Whipple's Route, Mamm. p. 14.—Hayd., Trans. Amer. Phil. Soc. xii., 1862, p. 147. (Niobrara R.)—Gerr., Cat. Bones Br. Mus. 1862, 175. —Coues, Am. Nat. i. 1867, 395. (Habits.)—Gray, P. Z. S. 1868, 201.—Allen, Proc. Bost. Soc. xvii. 1874, 42. (Yellowstone.)
Dipodomys montanus, Baird, Proc. Acad. Nat. Sci. Phila. vii. 1855, 334.

Hab. Rocky Mountain region at large, and somewhat eastward, from the region of the Yellowstone into Mexico. Limit of southern extension not precisely known. Specimens examined from the Yellowstone, Powder, Niobrara, Platte, and Arkansaw Rivers; from various localities in Texas, and nearly throughout New Mexico and Arizona; from Sonora, Durango, and Coahuila, Mexico.

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[1] The ascribed locality is obviously and unquestionably erroneous. The label "James Reed, South Carolina," like that on some other specimens of various animals I have seen, indicates the donor and *his residence*.

Chars. Larger: rather over than under 4 inches in length of head and body, with (comparatively) stout shape, small ears, short limbs, and short tail. Tail vertebræ one inch (more or less) longer than the head and body, bearing a proportion of about (rather less than more) 1.25 to 1.00. Coloration light; upper parts nearly uniform tawny-brown of the shade peculiar to the genus, darkened a little with mouse-brown on a dorsal area.

This form of the genus appears to have been first noted by Dr. Woodhouse, in 1853, all the other names being referable to the other. His specimens were from El Paso. The known limits of its dispersion were enlarged in 1857 to include the region of the Platte; while specimens still more recently examined show that it extends northward to the Yellowstone at least, further east in Dakota, Nebraska, and Kansas than was formerly supposed, and even reaches to Arkansas, where specimens were lately procured at Fort Cobb.